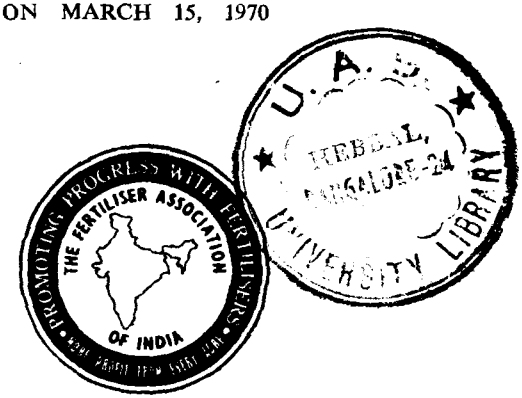
SEMINAR
ON
FERTILISER MIXTURES

THEIR ROLE, CURRENT TRENDS AND FUTURE PROSPECTS

PROCEEDINGS

ORGANISED BY THE SOUTHERN REGIONAL COMMITTEE OF THE FERTILISER ASSOCIATION OF INDIA AT MADRAS ON MARCH 15, 1970



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FOREWORD

With the rapid technological progress in the manufacture of fertilisers, the trend throughout the world is towards manufacture of high analysis granulated NP or NPK compounds. India is no exception to this development. It is expected that high analysis granular complex fertilisers will have a major share in our future fertiliser production and consumption programmes. This technological development has, however, had an inadvertent effect on the mixed fertiliser industry in the country. Inspite of tremendous progress made in the production and consumption of fertilisers in India, the mixed fertiliser industry which is more than 65 years old, has remained at a comparatively low level of development. The reasons are many in number and diverse in nature.

The Southern Regional Branch of the Fertiliser Association of India organised a one-day Seminar on "Fertiliser Mixtures–Their Role, Current Trends and Future Prospects" at Madras on March 15, 1970 to review the situation obtaining in this industry, to analyse the reasons for its present position and to suggest measures to rehabilitate it so that it could continue to serve the cause of balanced fertilisation. This book contains the text of all the papers presented at the Seminar together with the speeches delivered at the inaugural function followed by a brief resume of the proceedings of the Seminar. This is perhaps the first publication of its kind appearing in the country. It brings together all relevant and useful facts of the mixed fertiliser industry and offers possible solutions for its problems. *I am sure readers will find this publication very useful.*

November 5, 1970
New Delhi

C. R. RANGANATHAN
Executive Director
The Fertiliser Association of India

Inaugural Session

WELCOME ADDRESS

S. PRABHAKARAN NAIR
Chairman
Southern Regional Committee
The Fertiliser Association of India

Hon'ble Dr. Satyavanimuthu, Mr. Balakrishnan, Ladies and Gentlemen,

I consider it a rare privilege and great honour to welcome you all to this Seminar. We are indeed very grateful to our Minister for Agriculture who, despite her pressing legislative and administrative duties, has kindly agreed to spare her time to be in our midst today to share our thoughts on a subject with which we are currently very much concerned. We all know how deeply she is interested in advancing the cause of agriculture. We are sure that our problems would receive her utmost consideration. We are fortunate to have her to inaugurate our Seminar. On behalf of the Southern Regional Committee of the Fertiliser Association of India, I extend to her a hearty welcome.

We are indeed equally fortunate to have with us Mr. Balakrishnan, Commissioner for Food Production, Tamil Nadu Government, to preside over this inaugural session. We are also grateful to Mr. Hari Bhaskar, Director of Agriculture, Tamil Nadu, for agreeing to preside over the technical session.

I have great pleasure in extending a very warm welcome to them. I also extend a warm welcome to you all who have very kindly responded to our invitation.

The pivotal role that chemical fertilisers play in modern agriculture needs hardly any emphasis—at any rate not in an august assembly like this. Their importance, as a major source of plant nutrients essential for crop growth and for maintenance of soil fertility, has been very well recognised. The farmers, who initially showed reluctance towards the use of chemical fertilisers, have now recognised the real value of fertilisers as one of the essential inputs for obtaining increased production. This change has come about as a result of the intensive fertiliser promotion campaigns carried out during the last decade or so. Lately, with the introduction of high yielding varieties of crops, fertiliser consumption in

the country has begun to show signs of marked upward trend. The consumption of fertilisers at the end of the First Five Year Plan was at 1.2 lakh tonnes of nitrogen (N), 0.14 lakh tonnes of phosphate (P) and 0·12 lakh tonnes of potash (K). During the Second Plan period, the consumption rose to 2.12 lakh tonnes of N, 0.53 lakh tonnes of P and 0.29 lakh tonnes of K. At the close of the Third Plan, the consumption was 5.47 lakh tonnes of N, 1.32 lakh tonnes of P and 0.78 lakh tonnes of K. In the year 1968-69, just before the beginning of the Fourth Five Year Plan, the consumption of N, P and K was of the order of 12.53, 3.18 and 1.77 lakh tonnes respectively.

The introduction of chemical fertilisers to our farming community was initially a task undertaken by governmental agencies. While the Central Fertiliser Pool, which was initiated as a trading agency in 1942, mainly concerned itself with fertiliser procurement and supply, the Departments of Agriculture and Community Development of the State Governments and the Central Government concentrated on popularisation of fertiliser use among farmers. In the early years, the Central Fertiliser Pool obtained their fertiliser requirements mainly through imports and also from the production of the few public sector undertakings in the country. Subsequently, with the interest evinced by enterprising industrialists and traders, fertiliser became the business of private trade as well. Gradually, a good number of fertiliser factories began to operate. Thanks to the liberal and bold policies of the Government of India, today we have 48 fertiliser manufacturing units in the country with a capacity to produce 11.40 lakh tonnes of N and 4.34 lakh tonnes of P. More are under construction or under contemplation.

The southern region, comprising the States of Andhra Pradesh, Tamil Nadu, Mysore and Kerala, consuming nearly 45 per cent of N, 35 per cent of P and 50 per cent of K, distributed in the country, has within its geographical limits 15 manufacturing units with a capacity of 2.5 lakh tonnes of N and 2.0 lakh tonnes of P. These units are designed to produce single-nutrient straight fertilisers such as superphosphate, ammonium sulphate and urea and also multinutrient compound or complex fertilisers such as ammonium phosphate, ammonium phosphate sulphate and urea ammonium phosphate.

Fertiliser mixtures, about which we are concerned at this Seminar, have played a significant role in the balanced fertilisation of crops. The application of plant nutrients in balanced proportion, taking into cognizance the amount of nutrients needed by crops and the amount of nutrients available in the soil, has always been the underlying principle in our promotional programmes. Farmers,

many of whom were illiterate, did not have the technical know-how for balanced application of fertilisers in the early years of fertiliser introduction. Thus the idea to make available plant nutrients in mixed form in a single package was nurtured to develop. Initially, the mixtures were generally prepared for supplying balanced nutrients to plantation crops and subsequently this facility was extended to other cash as well as food crops. The mixture trade expanded very rapidly, especially in the southern States. The State Governments also started prescribing standard grades of fertiliser mixtures to suit different crop requirements. Thus, as you know, we have currently 18 standard grades of fertiliser mixtures in Tamil Nadu, 7 in Andhra Pradesh, 12 in Kerala and 13 in Mysore State. Out of more than 750 manure mixing firms in the country majority of them are in the southern region. In this region there are altogether 383 mixing firms in the private sector and 72 in the cooperative sector.

All the mixing firms in the country together had a turnover of 5·36 lakh tonnes of fertiliser mixtures in 1962–63, 7·97 lakh tonnes in 1964–65, 9·73 lakh tonnes in 1966–67, 8·98 lakh tonnes in 1967–68 and 7·53 lakh tonnes in 1968–69. The corresponding figures for the southern region were 3·47, 4·12, 6·84, 6·34 and 5·49 lakh tonnes respectively in these years. These figures would show a downward trend in fertiliser mixture consumption after 1966–67. When there is generally an upward trend in the consumption of N, P and K in the country, the question arises why is it that the fertiliser mixture consumption shows a declining trend ? All of you in the fertiliser trade know the causes. I would not like to dilate on them as we are going to consider them in detail in our deliberations today.

However, there is one aspect to which I would like to draw the attention of the Government. The fertiliser ingredients which go to form a mixture already suffer sales tax. After the mixture is made, there is sales tax once again imposed at the time of sale of the mixture. There is thus double incidence. This is in contrast to straight fertilisers which attract sales tax at the initial sales only. The higher cost of mixtures due to double incidence of sales tax thus works against the wider use of mixtures. It is only proper that the sales tax on all fertilisers, whether in straight form or mixtures, should be only at single point.

In this connection I would also like to refer to the proposed levy of surcharge on sales tax by the Tamil Nadu Government. The industry which is already passing through difficult times will not be able to bear this additional burden. The farmer is already complaining about the cost of fertilisers. Any further increase in price, however slight it may be, is bound to affect consumption

and retard the progress of agricultural production. I would, therefore, strongly urge the Government of Tamil Nadu to exempt fertilisers from the proposed levy so that we may not stem the tide of green revolution. I would even go a step further and earnestly plead that the sales tax as such on fertilisers may be abolished altogether as has been done in the State of Maharashtra.

For several decades in the past, the fertiliser mixing firms assiduously worked to prepare mixtures as per specifications of the Department of Agriculture. They have invested considerable amounts to organise large network of distribution system for taking the mixtures to the farmer. Quite an amount of effort has also been put in promotional activity to make the farmer conscious of balanced fertilisation. Furthermore, credit facilities were also offered in deserving cases, oftentimes resulting in considerable outstandings. The mixing firms have thus done a signal service for increasing the consumption of fertilisers and to the cause of balanced fertilisers.

For some time past, the mixture trade has been facing vicissitudes. It is essential that this large body of private mixing trade should be enabled to continue to serve the country and the cause of agriculture as well in future as in the past.

It is said that the future is not for mixtures in powdery form and that granulation and bulk blending are advisable. It is for this body of eminent scientists, administrators, industrialists and other representatives of the mixing trade to analyse the problems and decide how best mixing firms could be sustained. I am sure that our deliberations will be quite fruitful.

Let me once again extend to the Hon'ble Minister and to you all a hearty welcome.

INAUGURAL ADDRESS

SATYAVANIMUTHU
Minister for Agriculture
Tamil Nadu

I am thankful to Mr. Prabhakaran Nair, Chairman of the Southern Regional Committee of the Fertiliser Association of India, for having invited me to inaugurate this Seminar on " Fertiliser Mixtures ". At the outset I would like to state that the policies regarding fertiliser manufacture, import, distribution, levy of taxes and fixation of prices devolve on the Central Government and that the main role played by our Government is with regard to consumption of fertilisers.

Fertiliser is one of the main sources by which increased food production can be achieved. Fertiliser mixtures supply all the major nutrients and thus they ensure balanced manuring.

Trend in fertiliser consumption

In the southern States we find a steady increase in the consumption of fertilisers until 1967-68 followed by a drop in the consumption in 1968-69. We find a decline in the consumption of all nutrients in Tamil Nadu, N and P in Andhra Pradesh, P and K in Mysore State and P only in Kerala. This reduction is largely due to failure of seasons in the southern States in 1968-69.

The steady increase in the consumption of nutrients is not only due to additional areas brought under cultivation and under irrigation but also due to increased consumption per unit area. The per hectare consumption of these nutrients in India which was at 2.17 kg. in 1961-62 increased to 6.88 kg. in 1966-67 and during this period the per hectare consumption rose from 4.60 to 14.38 kg. in the southern States.

The per hectare consumption of nutrients during 1963-64 in Tamil Nadu was 6.23 kg. of N, 1.45 kg. of P and 1.54 kg. of K. The corresponding figures for 1968-69 are 12.45, 2.43 and 3:13.

However, when we compare the consumption of nutrients in various

countries on a per unit area basis we stand among the last few countries. Japan which produces the largest quantity of rice in an unit area consumes 35 times more of nutrients than India. This clearly indicates that there is still scope to increase the consumption of fertilisers. We have only to create congenial atmosphere for increasing the consumption.

In Tamil Nadu, the consumption of N, P and K has considerably increased to 1.13 lakh tonnes, 0.35 lakh tonnes, and 0.31 lakh tonnes in 1968-69 from 0.33 lakh tonnes, 0.08 lakh tonnes and 0.04 lakh tonnes in 1961-62. However, we will have to go a long way in increasing the consumption in order to catch up with the advanced countries like Japan, West Germany and the United States of America.

As regards the consumption of fertiliser mixtures in Tamil Nadu, it has gone up from 2.75 lakh tonnes in 1964-65 to 3.01 lakh tonnes in 1968-69 as against the total all-India consumption of 7.97 lakh tonnes and 7.53 lakh tonnes in 1961-62 and 1968-69 respectively. The southern States have consumed nearly 75 per cent of the total mixtures produced in India.

You are all aware that the consumption of mixtures is on the decline from 1968-69 onwards and further decline is noticed during the current year. I would appeal to the delegates to investigate the factors responsible for such decline and find out suitable ways and means of increasing the consumption of mixtures.

On Government side, all possible help will be extended to sustain the trade and promote consumption of mixtures.

Efforts of the Government to promote fertiliser use

Now that the system of registration has been introduced in place of licensing system, the people are at full liberty to deal in fertilisers at all levels without much restrictions.

Large-scale demonstrations on multiple cropping, composite demonstrations and national demonstrations are conducted with a view to educate the farmers on balanced manuring.

Wide publicity is made through farmers' forum organised by the All-India Radio and the listening groups set up under the Fertiliser Training Programme.

Fertiliser festivals are conducted in association with private firms. Exhibitions

are organised where various kinds of fertilisers are displayed and literature on the efficient utilisation of N, P and K fertilisers are distributed to visitors.

There are at present 7 soil testing laboratories functioning in the State where systematic analysis of soils is done in order to assess the fertility status of soils and to recommend to the farmers the right doses of fertilisers for crops for better production.

Soil fertility maps for all the districts have been prepared based on the results of analysis of soil samples to serve as guide-lines for farmers for adopting correct manurial schedules.

Credit facilities

At present credit is extended to farmers by the Government, the cooperatives and the banks.

A sum of Rs. 6.24 crores under the Intensive Manuring Scheme and a sum of Rs. 62.50 crores under the cooperative loans have been set apart for the current year to meet the credit needs of the farmers with regard to essential inputs including fertilisers. Out of this, a sum of Rs. 2.56 lakhs under the Intensive Manuring Scheme upto December, 1969 and a sum of Rs. 37.88 crores under the cooperative loans upto January, 1970 have been disbursed.

Special programmes

With the onset of the favourable North-East monsoon a crash programme for IR 8 paddy cultivation is being implemented in the districts of North Arcot, South Arcot and Chingleput to cover an area of about 3.3 lakh acres. Under this scheme inputs like fertilisers, seeds and pesticides are delivered at the door-steps of the farmers.

The village cooperative societies have been instructed to distribute N, P and K nutrients in definite proportion and also in accordance with the level prescribed by the Department of Agriculture.

The panchayat unions have also come forward to stock and distribute fertilisers including mixtures along with seeds and pesticides so that the growers can purchase the essential inputs at one and the same centre. This is being encouraged.

Promotional activities of the private trade

It is heartening to note that the private trade is evincing keen interest in the

promotional activities by actually participating in the various functions and exhibitions, organised by the Government.

Some of the reputed firms have established their own extension wing to work in close liaison with the sales wing. Some firms like the Madras Fertilisers Limited have gone a step further in organising a special squad for intensifying the sales of complex fertilisers.

The manufacturing firms have increased the number of retail points to step up consumption of fertilisers. Some private firms are also conducting demonstrations in ryots' holdings by supplying fertilisers free of cost. Farmers are invited to see the different stages of crop growth in the demonstration plots as a measure to impress upon them the principle of balanced manuring.

Many firms have their own audio-visual aids for educating the ryots on balanced manuring. They maintain mobile propaganda vans to screen films on fertilisers in the villages.

They also organise exhibitions, fertiliser festivals and distribute literature on fertilisers to farmers.

Some leading firms have formulated training programmes to train the salesmen of the cooperative societies and the farmers.

They are also advancing short term loans to the distributors and the farmers. The efforts taken by the firms are really commendable.

At present there are 140 manure mixing firms engaged in the preparation of fertiliser mixtures. The volume of mixture trade has substantially increased. There are, on the whole, 11,000 retail points in the State to enable ryots to get their requirements within easy reach.

With the availability of straight fertilisers and compound fertilisers at lesser cost, the mixing trade is facing stiff competition. Hence there is need for the reduction of the cost of mixtures.

The mixing firms may also explore the possibility of bulk blending. They may prepare mixtures in granulated form which will attract farmers as in the case of complex fertilisers.

There is also need to reduce the number of standard mixtures with a view to avoid confusion among the illiterate farmers who constitute the majority at present.

It is more appropriate that the Seminar of this kind has been organised by the Fertiliser Association of India at this critical juncture and I have no doubt in my mind that the deliberations of the Seminar will pin-point on the problems facing the trade and explore the ways and means to improve and sustain the trade. I wish the organisers all success.

PRESIDENTIAL ADDRESS

T. A. S. BALAKRISHNAN
Commissioner
Food Production, Government of Tamil Nadu

Hon'ble Minister, Mr. Prabhakaran Nair, colleagues and friends,

I am happy to be here in your midst today. I am very thankful to the organisers of this function for having given me the opportunity to familiarise myself with the problems of this particular trade. At the outset, your organisers wanted me to prepare an address which could be cyclostyled and communicated to you. I did not agree to this course of action because I did not want a stereotyped address. I wanted to talk to you informally and in the process I wanted to crystallize the problems or the issues that are faced by the trade.

I and the Government of Tamil Nadu are deeply interested in your problems. We would certainly like to associate ourselves with the deliberations of this Seminar ; and at the appropriate time, if you choose a small group of people, we would be happy to meet them and discuss your problems in greater detail. As for my address, I shall make it very brief and restrict myself to just a few observations.

I would like to take this opportunity to congratulate the Minister for Agriculture in mounting the *Navara* programme in the North Arcot, Chingleput and South Arcot districts. The result in the programme has been well beyond our expectations. We asked the Collector of South Arcot to take up a lakh acres during this season for planting paddy. He has been able to get 1.8 lakh acres planted. Similarly, 2 lakh acres in North Arcot and very nearly that area in Chingleput have come under that crop. Now this programme is an intensive programme in which we did make special attempts in regard to the activities of the various departments. As a result, the crop has been fairly good, much good and yet to be harvested. And I do not want to say anything that will cast an evil eye on the crop (*Laughte*). But, nevertheless, a lesson has been brought home that it is possible for the Government to mount a short term programme like this in a limited area and bring 6 lakh acres under paddy and to that extent increase our food production.

This is important to you from the point of view of the trade. It is important in the sense that it will create opportunities for fertiliser sales that were not normally there some ten years ago. We will have more and more of this kind of programme. I would like to take this opportunity to say a word about Mr. Antony, the Collector of Thanjavur. He is mounting from today onwards, a programme for *Kuruvai*. In this programme, he is trying to associate as many departments as possible, and he is co-ordinating the activities of the various departments that go into food production. The Agricultural Department provides inputs, or assistance in regard to inputs. The Cooperative Department provides inputs and the loans. Various other departments also help in this matter.

As part of this process, some time ago, in one of his divisions, he collected about 100 ryots from that area. There were a number of experts in agriculture and others who explained to the ryots how the crop had to be raised, what kind of nursery, how many days in the nursery, what kind of basal dressing, what kind of top-dressing, what was the exact quantity to be used and so on. I found that the ryots could give a point or two to the agricultural officers who were demonstrating in these meetings. They knew what they were talking about. They were cross-examining the experts with a view to get more information to get enlightenment and several of them were able to explain the practices that they had adopted and verify whether those practices were sound or not and whether they could continue such practices or not. I am told that the Collector is going to hold 720 meetings in 720 different villages between now and the first of June. This is an occasion for publicity, propaganda and education of the ryots. You will never get this kind of opportunity. I will be grateful if your Association will consult Mr. Antony and see whether it could give any practical help in the selling of fertilisers in that area. After all, in the next season they are going to bring under the plough probably a million and a half acres of paddy They will need a lot of fertilisers in the next six months.

If you are able to educate the ryots and to project your image with the adequate number of salesmen, the right quality of fertilisers, the right quantity of fertilisers, and at the right time, I feel no reason why any fertiliser seller should have any difficulty at all. Of course I do admit that there will be lots of difficulties in providing the right quality in the right quantity and at the right time. After all, your basic problem is that you have a million and a half acres. You will have to take 75 kg. or 100 kg. or 82 kg. or 39·32 kg. or whatever it is to that particular point where it has to be applied and this has to be done within a short

interval of 3 to 5 days, when the ryot wants it. I mean a day earlier—he is not interested, a day later—is no use at all and this is a gigantic problem in logistics. It is in this that I would appeal to you to help. Any help that you want from the department, we will endeavour to give to the best of our ability. But basically in this we should be on the same side of the fence. I hope we are.

You have in this Seminar a number of papers. Your organiser has given me these papers and I have had the privilege of going through them. Two people from Maharashtra have a brief note on intensive promotional activities. Promotional activity is something about which you will have to do a lot. I am absolutely certain in my mind, and I think that you will completely agree with me, that the promotional activities that you do are practically negligible.

Even certain enlightened firms are doing precious little by way of promotional activities. Their advertisement is not much, and their pamphlets are pretty dull. I do not think they show any film in these areas. My point is, unless you are able to interest the ryot, you have lost the game even before you have begun to play it. Interesting the ryot is the most important thing that you have got to do. Your publicity campaign, as far as I can see it, is certainly not likely to make one love fertilisers. Please think about it. It is something, which is within your power to improve. I do not see any reason why it should not improve.

Mr. Karuppannan has given a brief note on the problems in regard to the trade. He lists them as reduction in cost, quality control, bulk handling, sales promotion and loan arrangements. Briefly stated, they are your problems. In fact other papers repeat them. And when I end up I will have a word to say about these problems.

Mr. Revappa gives a brief note on conditions in Mysore State—a very brief note—but it is a good note.

Mr. Ramaswamy and Mr. Ambikacharan have given two notes on the role of balanced manuring. They have raised a few points. There are some insinuations about the Government saying that we are anti-mixers, so on and so forth. I do not know from where they got the idea, for we are not anti-anybody, but we are for everybody (*Laughter*). There is one thing I would like to say in regard to mixing firms when they say that they should get more nitrogen. There is no difficulty in getting nitrogen. I don't think there is any difficulty at all in giving them as much nitrogen as phosphate or potash as they need. Mr. Ramaswamy wants that the membership of the Fertiliser Association of India

should be thrown open to small mixing firms. It is certainly a matter that should be considered by the Association. He wants a code of conduct in mixing. I think it is a very good idea. He wants sales tax exemption. About this let me say at the outset that there is no use asking for exemption. We are just not in favour of it. Let us know the precise cost of doing things. All that you ask for should be your price. You should not ask for this exemption or that exemption or other concessions. I am quite sure the Hon'ble Minister will also agree with this.

Mr. Radhakrishnan, in his paper, puts out a plea for NK mixtures, instead of NPK mixtures. He wants fertiliser workshop, standard fertiliser mixtures modified, demonstrations and publicity. I am glad to note that several of the writers think that publicity is a point that has got to be looked into.

I would like to draw your attention to Mr. Warriar's paper, a brilliant paper. He presents the case very fairly. He is not particularly sympathetic to mixing firms. But, nevertheless, they have to learn to live with the times. Mr. Warriar's paper has got a lot of statistics. So has Mr. Radhakrishnan's paper. I think Mr. Radhakrishnan provides a lot of statistics which would be useful to all of us.

Summarising all this, your problems are simple. There is some difficulty in regard to quality control. You blame that I keep the fertilisers in my godown and the nitrogen content is not upto standard. In any case, right now I hold about 60,000 tonnes of diammonium phosphate costing Rs. 6 crores. I am going to mount a programme. Nobody is going to stop me from selling 60,000 tonnes in the next year or two. We are going to liquidate the stock. In fact all my efforts will be towards that. But, leaving that aside in regard to mixing firms, whatever you need, we will certainly make an effort to provide. Secondly, in regard to quality control, some tests and analysis in laboratories have been suggested; you can go into the details. Whatever you want, we will certainly consider. But I think everyone should be his own quality-control-man and ultimately the ryot is the super-quality-control-man. If your quality does not conform, he does not come back to you again. This is a question of your trade reputation. You please think about it.

In the loan arrangements, I see some difficulty. This is an area in which you are certainly not operating at all. I mean you are not aware of the problem. You are not seized of it and you are not doing anything about it. A million and a half acres require Rs. 500 worth of fertilisers per acre. It is a lot of money. Unless manure loans are provided on a large scale, it will

not be possible for the ryots to buy fertilisers. And if it is not possible for the ryots to buy fertilisers, you cannot sell fertilisers. Now this is a point : the need of the cultivator in the cultivating season. He has no money. He has to find the cost of cultivation, which varies anywhere between Rs. 450 to 900 an acre, depending on the type of crop, the type of irrigation and the type of inputs he needs. This money has to be provided for him. And for a long time we were under the impression that the cooperative societies were doing it. The cooperative societies are doing a lot, nevertheless, this is not enough. The second important point that has arisen in the last few months is that technological innovations and the use of high yielding varieties have led to the high use of fertilisers and high cost of cultivation. At no time is the ryot prepared for the higher cost of cultivation. So some kind of financial arrangement which will enable the ryot to have the money in his hand, with which he could buy the fertilisers, is necessary. In Thanjavur, we could start a new scheme by which every ryot is registered by a bank. His holdings and his needs are vouchsafed for by the department. He gets an overdraft or a loan or whatever is given by the bank as an advance for Rs. 600 or Rs. 700 an acre or at some such figure that he indicates. The bank pays the cultivator for his cultivation expenses. The bank pays the money to the fertiliser seller. At the end of the season, this money is collected from the cultivator. When I was talking with the cultivators, they said that it will be easier for them to give it in the shape of grain. Here, the Food Corporation of India may come and pay the cash to the bank and collect the grain. This kind of arrangement can be made in places like Thanjavur. For a million and a half acres, you will need about Rs. 80 crores credit in the cultivation season. It will be to the benefit of the bank. It will be to the benefit of the fertiliser seller. It will benefit the Government as the levy in food grain procurement will be resolved. This is a kind of arrangement that can be done only when there is proper co-ordination at all levels. I am quite sure in due course we will move towards it. It will take some time. Ultimately, when your high yielding varieties and your high quality fertilisers produce a surplus of food grains, there is going to be a fall in price. This system will have to be provided with a farm support programme at that stage. That is not very far away, may be 8 to 10 years from now. That is my estimate. You may have different views. These problems are there. I would suggest that you take counsel, and after you have done that, if you put down your suggestions, we could meet together and have discussions. I am quite sure that under the chairmanship of my distinguished colleague, Mr. Radhakrishnan, you will be able to arrive at sensible suggestions which could be supported by the Government.

Technical Session

FERTILISER MIXTURE INDUSTRY IN INDIA —ITS PAST PRESENT AND FUTURE

V. K. SAOLAPURKAR and S. V. BALKUNDI
Department of Agronomy
The Fertiliser Association of India

Among the various inputs of the new strategy of agriculture, maximum emphasis has been rightly laid on judicious and balanced use of fertilisers. About 50 per cent increase in food grain production is expected to come from fertiliser application, and thus it is the most important factor contributing to increased agricultural production. The full potential of the seeds of high yielding varieties, another equally important input of the new strategy, can be realised only when they are supplied with adequate quantities of plant nutrients in balanced proportions. The application of plant nutrients in balanced proportion is very important for raising the yield and maintaining the quality of the crop and the productivity of the soil. Maximising production implies that all the elements necessary for crop growth are supplied in suitable proportion as per soil analysis and crop requirements. Balanced fertilisation can be achieved either by applying the several plant nutrients through straight fertilisers, fertiliser mixtures or complex fertilisers. However, under Indian conditions, the farmers have neither the technical know-how nor the facilities to supply all the major nutrients, nitrogen, phosphate and potash, separately to crops in judicious combinations. Balanced fertilisation, under our conditions, can, therefore, be ensured better through making these nutrients available in a single package either in the form of fertiliser mixtures or complex fertilisers. The mixture manufacturers have made pioneering efforts in this field. Keeping in view the topic of the Seminar, this paper reviews the growth of the fertiliser mixture industry in India, analyses the trends in consumption of fertiliser mixtures in the past few years and suggests possible measures to improve the present situation obtained in this industry.

Development of the fertiliser mixture industry in India

The fertiliser mixture industry in India is as old as fertiliser industry itself and has been in existence for more than 65 years. The first mixture factory to be operated on a commercial scale came into being in 1904 at Ranipet near

Madras. This was followed by another factory in Kerala in 1911. Fertiliser mixtures were then prepared for supplying balanced nutrition mainly to plantation crops. This facility was subsequently extended to cash and food crops. Now fertiliser mixtures are available for almost all crops.

In the last 65 years the mixture industry has grown considerably in size and today we have more than 750 mixture manufacturers in the country. The regionwise distribution of fertiliser mixture manufacturers in India as of 1968-69 is given in Table 1, together with statewise details for the southern region.

TABLE 1

Regionwise Distribution of Fertiliser Mixture Manufacturers in India (1968-69)

Region/State	Private	Cooperative	Total
Eastern region	52	5	57
Northern region	14	2	16
Southern region	383	72	455
Western region	122	112	234
All-India	571	191	762
Southern region			
Andhra Pradesh	101	4	105
Kerala	14	2	16
Mysore	155	31	186
Pondicherry	4	2	6
Tamil Nadu	109	33	142

It is observed from Table 1 that the mixture business is mainly concentrated in the southern and western regions of the country. These two regions together account for 90 per cent of the total mixture manufacturers, with the southern region alone having nearly 60 per cent of the total mixture manufacturers. In the southern region, Mysore State leads in having the largest number of mixture manufacturers followed by Tamil Nadu, Andhra Pradesh, Kerala and Pondicherry. The tremendous growth in the mixture industry has reflected itself in the increase

in fertiliser mixture consumption and also contributed substantially to the growth of fertiliser consumption in the country, although of late only a small proportion is consumed through mixtures, as seen from data in Table 2.

TABLE 2

Consumption of Fertilisers (Nutrients) and Fertiliser Mixtures (Materials) in India

Year	Nitrogen		Phosphate		Potash		Fertiliser mixtures	
	Tonnes	%rate of growth	Tonnes	%rate of growth	Tonnes	%rate of growth	Tonnes	%rate of growth
1956-57	123,057	...	15,874	...	...	...	161,579	...
1957-58	149,019	21.1	21,922	38.1	...	...	191,424	18.5
1958-59	171,988	15.4	29,490	34.5	...	...	285,272	49.0
1959-60	229,326	33.3	53,930	82.9	21,342	...	339,346	18.9
1960-61	211,685	—7.7	53,134	—1.5	29,052	36.1	345,861	1.9
1961-62	291,536	37.7	63,932	20.3	27,982	—3.7	412,439	19.2
1962-63	360,033	23.5	81,385	27.3	36,503	30.5	497,862	20.7
1963-64	406,976	13.0	116,674	43.4	50,570	38.5	591,067	18·7
1964-65	434,473	6.8	147,652	26.6	70,440	39.3	797,302	34.9
1965-66	547,363	26.0	132,178	—10.5	77,746	10.4	771,473	—3.2
1966-67	838,736 (7.9)	53.2	248,602 (33.7)	88.1	115,710 (63.9)	48.8	973,027	26.1
1967-68	1,051,785 (7.9)	25.4	422,096 (19.3)	69.8	205,578 (33.2)	77.7	898,000	—7.7
1968-69	1,253,953 (5.6)	19.2	318,351 (20.3)	—24.6	177,567 (32.2)	—13.6	753,221	—16.1

Figures in brackets indicate the percentage consumption through fertiliser mixtures.

It is seen from Table 2 that the consumption of nitrogen has increased ten-fold from 123,057 tonnes in 1956-57 to 1,253,953 tonnes in 1968-69. The consumption of phosphate increased nearly twenty-fold from 15,874 tonnes to 318,351 tonnes in the same period and potash from 21,342 tonnes in 1959-60 to 177,567 tonnes in 1968-69 registering nearly an eight-fold increase. The consumption of fertiliser

mixtures has also increased in the last thirteen years from 161,579 tonnes in 1956-57 to 753,221 tonnes in 1968-69. There has been, however, a decrease in the consumption of fertiliser mixtures from 1967-68.

The quantities of various straight and complex fertiliser materials used in mixtures depend upon the grades of mixtures and materials used. Gradewise data of mixture consumption are not available. Hence it is not possible to estimate precisely the quantity of nutrients consumed through mixtures. However, the average data of the mixture grades existing in the country for the last three years broadly indicate that about 8 per cent of the total nitrogen, 34 per cent of the total phosphate and 64 per cent of the total potash were consumed through mixtures in 1966-67. These percentage contributions through physical mixtures have unfortunately come down in 1968-69 to 5, 20 and 32 for nitrogen, phosphate and potash respectively. One of the reasons for this decline appears to be large-scale use of high analysis complex fertilisers and NPK granulated compounds. In the year 1968-69, the consumption of nutrients through high analysis complex fertilisers and NPK granulated compounds amounted to 10, 60 and 5 per cent for nitrogen, phosphate and potash respectively.

As in the case of distribution of mixture manufacturers, the southern region leads in the consumption of mixtures, accounting today for nearly 73 per cent of the total consumption followed by western, eastern and northern regions. Within the southern region, Tamil Nadu tops the list in fertiliser mixture consumption followed by Kerala, Mysore State and Andhra Pradesh. The role played by 455 mixture manufacturers in the southern region in increasing the share of the region in the overall consumption of fertiliser mixtures in the country is commendable.

It would also be seen from Table 3 that the mixture consumption has decreased considerably in the eastern region in the last five years perhaps because of the ban imposed by the Government of West Bengal on the sale of non-granulated fertiliser mixtures in that State. The consumption has gone down in the other regions too, although not in the same magnitude. The decrease started from 1967-68, although the total consumption of N, P and K in that year had increased over that in 1966-67. It would be interesting to analyse for the decline in consumption of fertiliser mixtures since the past two years.

Decline in fertiliser mixture consumption

To meet the growing requirements of fertilisers and also to support the seeding programmes of some companies and to supplement the indigenous production, the

TABLE 3

Regionwise Consumption of Fertiliser Mixtures

(in tonnes)

Region/State	1964-65	1965-66	1966-67	1967-68	1968-69
Eastern region ...	103,751 (13.0)	76,720 (9.9)	63,821 (6.6)	8,961 (6.6)	36,757 (4.9)
Northern region ...	21,854 (2.7)	10,377 (1.3)	14,881 (1.5)	12,576 (1.4)	5,842 (0.8)
Southern region ...	518,847 (65.4)	511,930 (66.4)	683,761 (70.3)	634,642 (70.5)	549,366 (72.9)
Western region ...	152,850 (19.2)	172,446 (22.4)	200,314 (20.6)	191,821 (21.4)	161,246 (21.4)
All-India ...	797,302	771,473	973,027	898,000	753,221
Southern region					
Andhra Pradesh ...	61,095	42,443	67,207	75,147	13,359
Kerala ...	94,845	104,733	124,170	142,459	146,977
Mysore ...	69,789	93,151	111,167	91,243	85,962
Pondicherry ...	...	32	46	...	2,026
Tamil Nadu ...	275,718	256,541	381,171	325,793	301,042

Figures in brackets indicate the percentage contribution of each region in the year.

Government of India imported fertilisers, particularly complex ones like diammonium phosphate and other high analysis granulated NPK fertilisers, on a large scale during the last two years. The imported diammonium phosphate was allocated to the States by the Central Fertiliser Pool and was readily available to the farmers. Secondly, a few complex fertiliser factories went into production in the same period in India. The intensive seeding programmes and promotional activities of the complex fertiliser manufacturers in the last two years, since the liberalisation of fertiliser distribution and marketing by the Government of India, have resulted in popularising complex fertilisers and have had a detrimental effect on the popularity of mixtures. The unfavourable weather conditions which obtained over considerable areas, particularly in the southern region in 1968-69, also contributed to the decrease in mixture consumption. The spectacular effect of nitrogen on crops, particularly on the high yielding varieties of cereals, and its easy availability due to

large imports and indigenous manufacture have favoured the exclusive use of nitrogen by many farmers, although most of the State Departments of Agriculture do recommend phosphate and potash for the high yielding varieties. The promotional activities relating to brand products without due regard to balanced fertilisation have also inadvertently contributed towards the tendency to single-nutrient application, mainly nitrogen, by farmers.

The second set of factors relates to the high price of mixed fertilisers, their low analysis value resulting in higher transport, storage and handling costs, the risk of adulteration in case of non-granulated mixtures, etc. The mixture manufacturers were offered nitrogen at the same price at which it was available to the farmers. The low analysis of the mixtures also acts as a deterrent to fertiliser mixture use due to high cost of transport and application. It is observed that out of 56 different grades prevalent in the country, more than 78 per cent of the grades have total nutrient contents of 30 per cent or less. The break-up of these grades is found to be as follows:

Group	*Range*	*Number of grades in the range*
	(per cent total nutrients in a grade)	
A	11 — 20	12
B	21 — 30	32
C	31 — 40	3
D	41 — 50	9

The grades in the group D are mostly high analysis granulated NP or NPK complex fertiliser, either manufactured in India or imported for the seeding programmes. With the commencement of production of high analysis NP or NPK granulated fertilisers in the country, the low analysis of the existing grades of non-granulated mixtures will further act as a barrier in increasing the mixture consumption.

Mixture making inevitably involves higher costs due to mixing charges, double haulage, storage, packing, etc. Even complex fertilisers may have to be supplemented with nitrogen, phosphate and potash to meet the requirements of particular crops and soils. To discourage the sale of mixtures due to high costs, fear of adulteration, relatively easy availability of complex fertilisers, etc., will have disastrous consequences, not only from the point of lowering the soil productivity due

to probable unbalanced fertilisation but also from the point of maintenance o soil fertility, and an established industry cannot be made to suffer and diminish it importance. The mixture industry has during its existence over 65 years built up a vast distribution network and has been instrumental in highlighting the importanc of balanced fertilisation and through it has contributed to the agricultural and economic development of the country. Keeping pace with the technologica developments taking place in fertiliser production, constructive steps to keep the mixture costs as low as possible and to make them competitive should certainly be considered.

Cost reduction in fertiliser mixtures

The mixture manufacturers can be classified into two broad groups, namely (1) mixture manufacturers who are also manufacturers of one of the ingredients and procure other ingredients from elsewhere and do the mixing job; and (2) those who procure all the ingredients and mix these in the proportions required to produce different grades. The first category includes mostly the superphosphate manufacturers. However, nitrogen to both the categories of manufacturers had to be procured from the allocations to the States made by the Pool or from the nitrogen manufacturers at the same price at which these were available to farmers. Due to mixing, transport and packing charges, the mixed fertilisers are more expensive. If their use is to be promoted on a larger scale in the interest of balanced fertilisation and maintenance of soil fertility it is necessary to lower their cost to the farmer. It is possible to reduce the cost of mixed fertilisers if the nitrogenous fertilisers are made available to mixture manufacturers at the Pool price and not at the consumer price. The Fertiliser Distribution Enquiry Committee and the Committee on Fertilisers of the Government of India had made this recommendation in 1960 and 1965 respectively. Adequate supplies of nitrogenous fertilisers should be offered at Pool prices to the mixture manufacturers. Supply of nitrogen should not be allowed to be a limiting factor in the production and consumption of mixed fertilisers. It is, however, necessary to ensure that the nitrogenous fertilisers marked for fertiliser mixture manufacture are not offered for sale as straight fertilisers, but are used for the manufacture of fertiliser mixtures. A suitable check system or control organisation could be set up or devised under the Fertiliser (Control) Order. The recent announcement of the Government of India offering imported fertilisers at the Pool prices to retailers and mixture manufacturers will help to lower mixture prices, although it will have a disruptive effect on the distribution network built up by the manufacturers. It

should be possible to extend the benefit of Pool prices to mixture makers, without damaging the distribution system. Mixture manufacturers should utilise the opportunity by accepting the imported fertilisers for mixture manufacture. This would certainly lead to a reduction in the cost of mixed fertiliser and serve as an incentive to increase the sale of mixed fertilisers.

Granulation

As pointed out earlier, the powder form in which at present the bulk of the fertiliser mixture is produced and sold in the market and the low analysis of the grades offer no incentive, particularly when granulated high analysis complex fertilisers are available at competitive or cheaper prices. The known advantage of granulation is that it provides products of standard quality and composition which helps in preventing fraud and adulteration, besides other physical advantages of storage, transport, handling and application. At present, there are only 3 or 4 granulated mixed fertiliser factories in the country. It is reported that the additional cost due to granulation is about Rs. 20 per tonne and that the granulated products have been well received. In view of the advantages of granulation and the fear of loss of faith in fertiliser use, due to danger of adulteration and fraud, through powder form fertiliser mixtures, both the Fertiliser Distribution Enquiry Committee and the Committee on Fertilisers recommended granulation of fertiliser mixtures as a step to increase the consumption of mixed fertilisers.

Another decisive advantage of granulation is that high analysis straight fertilisers like urea, triple superphosphate, diammonium phosphate, monoammonium phosphate, anhydrous ammonia, etc., could be used in formulation of high analysis mixtures. Even single superphosphate can be used as a base material and the phosphate content can be enriched through incorporation of monoammonium phosphate or diammonium phosphate. Results of preliminary studies on the possibilities of manufacturing high analysis fertiliser mixtures with single superphosphate as a base material reported recently at the FAI Seminar on Fertiliser Production and Technology revealed that it was possible to prepare granulated mixtures with total nutrients ranging from 37.5 to 45 per cent, using single superphosphate, urea, diammonium phosphate or monoammonium phosphate. The chemical compatibility of different fertilisers has to be taken into account before selecting fertiliser materials and the manufacture of high analysis granular mixed fertilisers. However, these mixtures have to be granulated to improve the physical condition of the products and to eliminate undesirable effects of mixing hygroscopic fertilisers like urea and superphosphate. Manu-

facture of such high analysis granulated fertiliser mixtures with single superphosphate as a base offers an opportunity to superphosphate industry, which is facing difficulties due to competition from complex fertilisers such as diammonium phosphate, to increase the consumption of superphosphate through such high analysis granulated mixture. However, the extra costs involved in granulation can perhaps be compensated by offering urea and diammonium phosphate to mixture manufacturers at Pool price or even at cost price by the Central Fertiliser Pool, in the interest of offering fertilisers at competitive price to farmers. Apart from this, the higher cost on account of granulation would be reduced if granulation can be undertaken in factories with fairly large production capacities which would ensure adequate technical and managerial supervision of production. Higher production capacity would reduce the cost of granulation and ultimately that of the granulated mixtures.

However, because of the higher costs involved in granulation process, it may not be possible for small manufacturers to invest in the process and they may have to continue the manufacture of powder form mixtures. Both the Fertiliser Distribution Enquiry Committee and the Committee on Fertilisers stressed the need for greater vigilance in enforcing the provisions of the Fertiliser (Control) Order relating to quality of fertilisers. For a few miscreants in fertiliser business, the fear of fraud and adulteration of fertiliser mixtures cannot be generalised for the whole mixture industry. Strict enforcement of quality control will certainly go a longway in dispelling the notion that powder form fertiliser mixtures are adulterated. Quality consciousness on the part of mixture manufacturers is also necessary in promoting the use of fertiliser mixtures. Government machinery for ensuring the quality of mixtures must be fully harnessed to put down the evil of adulteration.

Bulk blending

Another possible measure to increase the consumption of mixed fertilisers could be bulk blending of fertilisers. In the early days of fertiliser industry raw materials were seldom marketed in granular form. Today a wide variety of granular fertiliser materials are commercially available. If two or more granular materials having similar particle sizes are blended, the resulting blend has little tendency to become segregated or unmixed. This is a relatively new method of preparing mixed fertilisers and is known as bulk blending.

As in dry mixing of pulverised materials there is little chance of chemical

reactions occurring in blended fertiliser mixtures. Since the raw materials are granular, so is the product. Since no granulation of the product is needed, plant requirements are simple. A number of fertiliser materials can be used to prepare the products. However, all the fertiliser materials should have granules of more or less same size to avoid segregation during transport, storage and application. The full advantages of bulk blending can be attained if the product is applied to the soil soon after blending. Intermediate storage and handling are likely to cause segregation.

Bulk blending of fertilisers to prepare a mixed fertiliser is gaining popularity in the advanced countries because of the advantages it offers to the manufacturers as well as consumers. The application of such fertilisers is very easy through mechanicial means. Storage and segregation problems are not encountered. Bulk blending thus offers flexibility in analysis of mixture to suit soil analysis and crop requirements. A farmer can get the mixed fertiliser of the grade that suits his soil and crop best according to the soil test. Consumption of mixed fertilisers can be increased considerably through bulk blending and offering mixed fertiliser of the required grade. However under Indian conditions, where the variety of fertiliser materials produced have particle sizes ranging from powder to fine granules of 3-4 mm, how far this method of popularising mixed fertilisers would be useful and successful is yet to ascertained. It would be worthwhile to study this aspect of mixed fertiliser industry under Indian conditions.

Last but not the least is the promotional aspect. It is observed from the recent liberalisation in the fertiliser distribution system that a number of fertiliser manufacturers are actively engaged in promotional activities, like demonstrations, film shows, organising fertiliser festivals, distribution of fertiliser literature in local languages in popular style, etc. However, this is naturally confined to fertilisers with brand names of the products. An intensive promotional effort in popularising use of fertiliser mixtures for the balanced nutrition of crops and maintenance of soil fertility will boost fertiliser mixture consumption considerably. There is a great scope for intensifying the promotional activities, which should receive consideration by the fertiliser mixture industry.

PROBLEMS IN THE FERTILISER MIXTURE TRADE

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As a representative of the Tamil Nadu Government, I would like to express my sincere thanks to the Fertiliser Association of India for having given me this honour to participate in the Seminar.

I would first like to analyse and study what we have accomplished in this field and then would examine our failures. In the context of green revolution taking place in the country, our objective is to meet the growing needs of the farmers thereby to achieve self-sufficiency in food and other agricultural products and provide a better standard of living for the farmers who represent nearly 80 per cent of our population.

Fertilisers are carriers of concentrated plant food. They help to enrich soil fertility and facilitate sustained crop production. The profitable response of the soil for fertiliser application depends upon the use of the right kind of fertilisers, correct dose and methods of application. The nature of soils, crops, irrigation and climatic conditions greatly influence the choice of the fertilisers.

A proper understanding of the availability and limitations of the local manurial resources, the nature of soil and crop and climatic conditions is a pre-requisite for proper fertilisation. It has been proved beyond doubt that fertilisers, which are readily available and which have plant nutrients in a concentrated form, are the cheap sources of plant food, indispensable for increased and sustained crop production.

Fertilisers are classified under three categories, namely, straight fertilisers, complex or compound fertilisers and mixed fertilisers. The straight fertilisers supply a single plant food, namely, N, P or K. The compound and complex fertilisers supply N and P or N, P and K to the soil in a single application. Fertilisers generally contain N in nitrate and ammonical forms, P in water-soluble and citrate-soluble forms and K in water-soluble form. Those fertilisers

which contain nutrients above 30 per cent are called high analysis fertilisers. These fertilisers are cheaper than low analysis straight fertilisers on the basis of unit value. Further, the charges on transport and application are comparatively lesser for these fertilisers than straight fertilisers. A mechanical mixture of two or more straight, compound or complex fertilisers is called mixed fertiliser.

Need for a complete fertiliser

Recent experiments conducted in research stations indicate that for better crop production in certain soils, fertilisers should also carry other plant nutrients like calcium, magnesium, sulphur, copper, zinc and boron. A complete fertiliser should meet the total nutritional requirements of the soil and the crops including the micronutrients.

The Department of Agriculture has adopted manurial schedules for different crops based on the results of trials and demonstrations conducted in farmers' fields. The schedule includes N, P and K. Since it is very difficult for the farmers to mix and apply fertiliser at the prescribed nutrient levels, the Department of Agriculture is recommending ready-made fertiliser mixtures for major crops like paddy, sugarcane and banana. At present there are 13 standard mixtures in Tamil Nadu catering to the needs of different crops including high yielding varieties.

Advantages of fertiliser mixtures

The advantages in using fertiliser mixtures are : (1) There is considerable saving in time and labour in the application to the crops, since all the essential nutrients are present in one packing (2) It ensures balanced manuring to the crops. (3) Mixtures can be more easily applied to the soils than many straight fertilisers in view of the better physical condition. (4) The residual acidity of fertilisers can be minimised by including adequate quantity of lime in the mixture. (5) Micronutrients can be included in the mixtures. For example, boron can be incorporated in the standard mixture for groundnut crop. (6) In a country like ours, where the majority of farmers are illiterate, there is always the possibility of error in mixing the correct materials in proper proportions. Such errors are eliminated in ready-made mixtures.

Kinds of mixtures

There are two types of mixtures, namely, (1) open formula mixture and (2) closed formula mixture. In the former the ingredients are disclosed by the

manufacturers, whereas in the latter the ingredients are not disclosed. The former is preferable, since the farmers and the extension workers can decide the suitability of a mixture for specific crops and soils based on the fertilisers and fillers used in it.

The materials used in fertiliser mixtures can be grouped under the following four categories : (1) Suppliers of plant nutrients. (2) Conditioners as organic materials to reduce caking. (3) Neutralisers as dolomite to counteract acidity. (4) Fillers to make the bulk of mixtures.

A vivid knowledge of the chemical and physical characteristics of the individual material and their behaviour in mixture is essential in order to ensure the preparation of quality mixed fertiliser. Fertiliser mixtures are prepared either in the farms or in the factories manually or with the help of special equipments. The former is known as farm-made fertilisers and the latter as factory-made mixtures.

Complex fertilisers

The advantages of complex and compound fertilisers are : (1) The possibility of adulteration is generally ruled out. (2) Each granule is homogenous in nutrient content. (3) Application by hand drills is possible since they are available in granular form. (4) Cheaper than mixed or straight fertilisers. (5) Fixation of phosphate is reduced since there is less contact of soil particles with the fertilisers. (6) The cost of transport and application to the crops is much less.

The disadvantage of compound and complex fertilisers is that the ratio of the nutrients is fixed and the farmers have to add single-nutrient fertilisers to conform to the standards prescribed for the different soils and crops. This is really a difficult problem for the farmers. A possible solution to the problem would be to manufacture a fairly large number of fertiliser grades keeping in view the requirements of the farmers in different regions.

Crisis in the mixture trade

At present the mixture trade is facing certain problems. They are : (1) In as much as the supply position of the straight fertilisers has been considerably eased for the past two or three years, the ryots, who have been hitherto facing the shortage of straight fertilisers, have started going in for straight fertilisers in a large way resulting in the offtake of mixtures going down. (2) The recent imports of high grade fertilisers like diammonium phosphate, ammonium phosphate and

complex fertilisers, which are comparatively cheaper than the mechanical mixtures, have caused a severe set-back to the mixture trade. (3) The indigenous manufacture of the straight fertilisers and the compound and complex fertilisers have considerably reduced the demand for mixtures. (4) There is a general apprehension on the part of the farmers regarding the quality of the mixtures manufactured. There are widespread complaints from the extension workers and the farmers regarding the substandard quality of mixtures. (5) Even though the Fertiliser (Control) Order is implemented with the assistance of laboratory facilities to ensure quality control, the present facilities are not adequate to detect the fraudulent mixtures effectively. (6) Some new firms, who have entered the trade recently, do not attach adequate attention to the quality control, with the result that even the reputed firms are suspected. The fair name of the trade is tarnished by marketing substandard mixtures indiscriminately. (7) Recent experiments have shown that the soils and crops require micronutrients for better crop production and for maintenance of soil fertility. These are at present no incorporated in the fertiliser mixtures. (8) Although Government and other agencies are advancing loans to the cultivators for the purchase of fertilisers, the credit facilities extended to the small farmers are quite inadequate, with the result the offtake of mixtures is not satisfactory. (9) The sales promotion activities by the mixture trade have yet to gain momentum among the small farmers, who constitute about 80 to 90 per cent of the farming community. (10) The consumption of mixtures during 1969-70 upto the end of third quarter is 62, 366 tonnes. The corresponding consumption during 1968-69 is 176,661 tonnes. This clearly indicates that not even 50 per cent of the 1968-69 consumption is achieved during 1969-70.

Suggestions to tide over the crisis

In order to tide over the crisis facing this trade, the following solutions may be considered for discussion: (1) The cost of mixtures should be reduced at least on a par with NPK complex fertilisers based on the value of NPK nutrients present in each so that we may create a healthy competition between mixtures and complex fertilisers. (2) The work with regard to quality control of mixtures done by the Department of Agriculture is not adequate. The private trade must have their own system of quality control by establishing regional and central laboratories in addition to the laboratories of the Government. Perhaps the Fertiliser Association of India may explore the possibility of establishing regional as well as central laboratories for effective quality

control of fertilisers. (3) Sales promotion activities have to be strengthened. Demonstrations and trials in the farmers' holdings should be laid in large numbers to compare the efficacy of mixed fertilisers with complex and straight fertilisers, so that the farmers will be convinced regarding the performance of the various mixtures in regard to both quality and cost. Audio-visual aids may be used in large numbers to educate the illiterate farmers in the villages. For this, cooperation of private trade is quite essential. (4) The firms can take up bulk blending process so that the application to crops is rendered easy as in the case of complex fertilisers. (5) The mixture trade can combine phosphate with imported ammonia and urea to produce granulated high analysis compounds, so that the price can be brought down on a par with imported high grade fertilisers. (6) The present ratio of application of N, P and K is 4 : 1 : 1, as against the recommended ratio of 3 : 1 : 1. The mixture trade can play an active role in advocating balanced manuring. (7) The possibility of manufacturing mixtures containing NK alone may be explored by the trade to achieve the balanced manuring to some extent since the offtake of K is far below the recommended levels. (8) The sugar factories are advancing loans to the cultivators to purchase mixtures. Similar arrangements may be made either by the manure mixing firms or the nationalised banks.

I am sure that the participants would discuss the various problems facing the trade in detail and make the Seminar a success by having meaningful and fruitful deliberations so that the conclusions of the Seminar will pave the way for better prospects of the trade which is in crisis at present.

THE POSITION OF FERTILISER MIXTURES IN MYSORE STATE

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Mysore State has rich agricultural potential with a wide range of agro-climatic conditions. A variety of crops of temperate regions, humid regions, tropic and also arid regions are being grown. It is no exaggeration to state that no other State in the country can boast of such a variety of crops.

The food crops grown include rice, jowar, ragi, bajra, maize, wheat, minor millets and pulses. Commercial crops include cotton, oilseeds, tobacco, sugar-cane, mulberry and plantation crops like coffee, tea, rubber, cardamom, pepper, cashewnut, arecanut, and coconut. Mysore State has virtually the monopoly in coffee and raw silk production in the country. In addition to the above, fruit crops like citrus, pineapple, mango, banana, grape and a number of other kinds of fruits are grown. Out of the total cropped area of 108 lakh hectares, an area of 10.4 lakh hectares is under irrigation, which works out to about 10 per cent only. Thus a very large part of land in the State comes under rainfed cultivation.

Level of fertiliser consumption

The consumption of fertilisers, which was only 0.28 lakh tonnes in 1956-57 has gone up to 3 lakh tonnes in 1968-69. It has registered a phenomenal increase during the past few years, specially after the introduction of hybrid and high yielding varieties of crops in the State.

The use of fertilisers for crop production is becoming more and more popular among farmers of this State. They have realised the importance of fertilisers. The demand for fertilisers is going up year by year. The consumption of fertilisers during the years between 1961-62 and 1968-69 is furnished in Table 1.

TABLE 1

Consumption of Fertilisers

(in tonnes)

Year	N	P	K
1961-62	89,500	28,250	7,182
1962-63	100,118	36,148	8,489
1963-64	107,422	52,348	11,614
1964-65	96,003	57,711	15,958
1965-66	119,401	50,101	11,990
1966-67	157,354	58,796	20,414
1967-68	141,805	76,520	25,400
1968-69	216,000	73,300	19,425

Distribution system

There are no indigenous factories for the production of nitrogenous fertilisers at present in the State. The required quantity of these fertilisers has to be obtained either from the Central Fertiliser Pool of the Government of India or from manufacturing firms located outside the State. The distribution of Pool fertilisers has been entrusted to the Mysore State Cooperative Marketing Society on monopoly basis. The retail distribution of these fertilisers is being done through a network of taluka marketing societies and service cooperative societies at village level. In addition to this, the Mysore State Agro-Industries Corporation, a number of private agencies and also some of the manufacturing concerns have opened their sale depots in several areas in the State.

There are about 3,000 retail sale points in addition to 350 wholesale depots in the State serving the villages. The farmers are using both straight fertilisers as well as commercial mixtures. The use of balanced fertilisers is being advocated by the Department of Agriculture. The different doses of N, P and K to suit the crops as well as soil conditions are determined periodically at the State level fertiliser workshops. Some of the farmers prefer to use ready-made mixture in preference to straight fertilisers as it saves them labour and worry. The Department of Agriculture has fixed 13 grades of standard mixtures which

the mixing firms may manufacture for sale under the Fertiliser (Control) Order. The details of grades approved by the Department of Agriculture are furnished in Table 2.

TABLE 2

Standard Mixtures Approved by the Government

Serial No.	Grade	Crops
	N: P: K	
1.	9- 9- 9	Paddy, irrigated ragi, hybrid jowar, Mexican wheat, sugarcane.
2.	10-10- 0	Rainfed ragi, jowar, cotton.
3.	6-12- 0	Groundnut, paddy.
4.	6-12- 6	Groundnut for southern districts.
5.	12- 6- 6	Vegetables.
6.	12- 4-12	Mulberry.
7.	6- 6-12	Arecanut, coconut, cardamom, sea-island cotton.
8.	6- 9- 6	Cashew, paddy, cigarette tobacco.
9.	15- 5- 5	Sugarcane, cotton.
10.	14- 7- 0	
11.	15- 0-15	Banana, sugarcane, coffee.
12.	12- 6-12	Banana.
13.	7-10- 5	

The ceiling prices for standard mixtures at different points of sale are also fixed by the Department of Agriculture.

There are about 180 mixing firms in the State out of which only 90 are active at present. These firms are obtaining their requirement of straight fertilisers from the Mysore State Cooperative Marketing Society and also from the manufacturing concerns. The distribution of these mixtures is done through both cooperatives and private dealers.

In view of the increasing demand for fertilisers, particularly after the introduction of the high yielding varieties and adoption of intensive cultivation practices, there is need for more number of sale points in the interior parts of the State. Moreover the farmers are now applying fertilisers even to the rainfed crops to a considerable extent.

Quality control

In order to see that the mixtures sold to farmers conform to standards, the district officers of the Department of Agriculture periodically visit the

premises of the fertiliser firms and take samples for analysis. Suitable action under the Fertiliser (Control) Order is enforced if any fraud is detected. The work of analysis of fertiliser samples is now proposed to be taken up in the several soil testing laboratories of the State.

The total quantity of mixtures prepared and distributed during the period between 1965-66 and 1968-69 in Mysore State is given in Table 3.

TABLE 3

Consumption of Fertiliser Mixtures

(in tonnes)

Year	Quantity
1965-66	64,653
1966-67	89,945
1967-68	69,535
1968-69	53,444

Fertiliser mixtures *versus* complex fertilisers

There is a feeling that the number of fertiliser mixtures marketed in the State may be reduced. Efforts are now being made to find out whether a few grades of mixtures would cover the wide range of crops. The introduction of certain high analysis complex fertilisers like 12 : 12 : 12, 15 : 15 : 15, 12 : 24 : 12, 14 : 14: 14, 14 : 28 : 14 and 20 : 20 : 0, by some of the fertiliser manufacturing concerns has had an adverse effect on the sale of some standard mixtures. However, in view of the limited ratios in which the complex fertilisers are being manufactured, there is still a wide scope for fertiliser mixtures in the State and I feel that these standard mixtures will have their own place. The role of fertiliser mixtures is very important to maintain soil fertility and to get economic yields. The injurious effect of certain types of fertilisers on soil texture with the resultant low yields can be avoided by application of fertiliser mixtures. Due to intensive work of the Department of Agriculture and the other agencies connected with the fertiliser business, use of fertiliser mixtures has become fairly popular. To widen the scope for application of mixtures by larger number of farmers over a wide range of crops, I feel that the mixing firms should ensure supply of the quality mixtures to the farmers. Otherwise farmers may lose faith in the standard mixtures.

THE ROLE OF FERTILISER MIXTURES IN BALANCED MANURING

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The progress in the use of fertilisers in the southern region is largely due to the concept of balanced manuring fostered by fertiliser mixing firms. Nearly 45 per cent of the nitrogen, 35 per cent of phosphate and 50 per cent of potash consumed in the country is accounted for, by the southern region. This is an eloquent tribute to the scientific lines on which fertiliser promotion had been carried out by mixing firms for more than three decades past. By and large, the NPK formulae for various crops adopted by the pioneer mixing firms are still valid. Their instruction leaflets emphasised the need for basal application of organic matter. By way of highlighting this point they incorporated certain portion of organic nitrogen in their mixtures. They had laid a number of ocular and field-scale demonstrations on ryots' lands and educated the farmers on the correct quantity, timing and method of application of the different plant foods. Keeping abreast of latest trends in manuring and realising that the massive dosages of plant foods applied will bring about micronutrient deficiencies, they have started incorporating boron, manganese, zinc, etc., in their mixtures for select crops and soils.

Mixing firms have built up, over the years, a highly ramified distribution service through their dealership organisation. In Tamil Nadu alone, there are 120 mixing firms with over 7,000 selling points. Besides the large capital employed in the mixing business, they, and in turn their distributors, give extensive credit. The amount of credit in Tamil Nadu alone would be of the order of Rs. 2 crores. Their involvement in Andhra Pradesh, Mysore State and Kerala would be equally sizeable.

In collaboration with the Agricultural Departments they have been marketing an adequate range of fertiliser mixtures of approved analysis and composition, suitable for particular crops for application at different stages of growth. These mixtures have been well received and found to meet the plant food requirements, supplemented in certain cases by top-dressing of chemical nitrogen alone, or in conjunction with potash.

Aftermath of fertiliser decontrol

Under the impartial allocations of chemical fertilisers made by Government between 1944 and 1968, the mixing firms made rapid strides, and the concept of NPK balance was steadily fostered. But, under a major policy decision, intended perhaps to attract foreign investment in fertiliser industry, the Government decontrolled distribution and pricing of fertilisers since October, 1968. Although Government notionally retains the option to control 30 per cent of indigenous production, they have practically ceased making allotments to mixing firms and the latter have now to depend on manufacturers.

The manufacturers, in their anxiety to encash on their production, entered into monopoly distribution arrangements which impeded supplies to medium and small mixing firms. Apart from the hardship entailed to the latter, the farmers are deprived of their competitive services which, in the past, had made a large contribution to the progress of balanced manuring.

The monopolists are naturally anxious to offload their allotments in the market. The sales promotion activities of a manufacturer or wholesale distributor of urea, for instance, will naturally be geared to maximising sales in the shortest time possible, and he cannot be expected to exercise vigilance all along the distribution line to ensure the product being used in optimum balance with phosphate and potash.

Ever since decontrol of production in 1968, phosphate and potash consumptions have been out of step with nitrogen. Superphosphate stocks are accumulating in factories and production is at standstill. In spite of pressurised selling of diammonium phosphate and NPK complex fertilisers, large stocks remain unlifted from Government and cooperative godowns. It would spell disaster for the future progress of fertiliser use if, in the selling spree of straight nitrogen, the ryot is misled into thinking that nitrogen, is the only plant food that really matters and persuades himself into ignoring or temporising with the balancing role of phosphate and potash. The surest safeguard against such faulty, ill-balanced application of chemical manure is to promote conditions for maximising sale of approved standard mixtures by affording all encouragement to mixing firms.

The latest phase

The latest slogan is NPK complex fertilisers and granulated mixtures. There is a big boost for these items with a subtle insinuation against manure mixtures.

The arguments advanced in favour of complex and granulated fertilisers are: (1) They will not lend themselves to adulteration. (2) They are concentrated and hence more economical. (3) They are uniform in composition and analysis.

In this context, it is well to bear in mind that throughout the long period of fertiliser deficits, fertiliser mixtures were singularly above board, while large-scale adulterations were reported in straight fertilisers. There were salt manufacturers specialising in production of sodium chloride crystals or globules conforming in size and shape to ammonium sulphate or urea, and they were sold mixed or unmixed with the materials of which they were imitations. Therefore, even granulation is no guarantee against adulteration, and the scales need not be weighted against conventional mixtures on this score. Both granulation and conventional mixing could be allowed to exist side by side, depending purely on the economics of processing, subject only to mixtures analysing up to declared guarantee within permissible limits of tolerance.

NPK complex fertilisers by their very nature are not sufficiently elastic and can answer to needs of only a limited range of soils and crops. Under the massive applications of plant foods under high yielding programmes, the fertility balance in our soils is getting tilted fast. An NPK ratio that was good enough this season may not hold good for the next. Hence there will be increasing need for tailor-made mixtures based on up-to-date soil analysis. These could be best supplied by mixing firms. Therefore, we have need for many more mixture makers, even mobile mixture blenders, carrying fertiliser ingredients in trucks, blending and effecting spot delivery of fertiliser mixtures according to customer's recipe. It is therefore in national interest to preserve the mixing trade.

It is true that urea is the cheapest source of nitrogen today. But on that account we cannot taboo ammonium sulphate. Certain soils and crops have need for sulphur contained in ammonium sulphate. Similarly, the calcium sulphate contained in superphosphate is valuable as a soil improver. Usually the nitrogen and phosphate in manure mixtures are derived from more sources than one and this makes for optimum benefit to crops and soils. If mixtures appear costly, it is not due to any unethical profiteering indulged in by mixture formulators or dealers. It is due to the additional cost of repacking into polythene-lined new bags the ingredients that go to make up the mixture. In fact the prices of mixtures are severely controlled by the State Governments and the permissible overall profit to be shared throughout the distribution system is nothing more than is applicable to straight fertilisers. Government can help in reducing the prices by waiving sales

tax on fertiliser mixtures. Every ingredient that goes into composition of a mixture suffers initial sales tax, and therefore, there is every case for waiving sales tax on fertiliser mixtures especially manual mixtures, in which the ingredients retain their identity and could be physically sorted out.

Need for organic nitrogen in mixtures

Following the recommendation of Sivaraman Committee, the State Governments in the southern region have tabooed the presence of organic nitrogen in standard mixtures, with a view to reducing prices of mixtures making for their better economy and acceptance. But in practice, the ryot, out of his fund of experience, sets a large store on presence of organic ingredients in mixtures. We, The Scientific Fertiliser Company Private Limited, have been selling a 6 : 12 : 6 mixture for potato in the Nilgiris of which 1 per cent out of the total 6 per cent nitrogen is being provided in organic form. Despite a difference in price of about Rs. 60 per tonne against the organic mixture, our customers continue to buy this mixture in preference, and would not accept its all-chemical counterpart. Even on the plains many of our customers would have us sell mixtures containing a portion of the nitrogen in organic form. In fact, quite a few of them are even now supplementing chemical standard mixtures with oilcake in some form. They point out that the action of organic mixtures is both smart and sustained, whereas the action of the present all-chemical mixtures is short-lived. I am sure, if a consensus of ryots using manure mixtures is taken, they will vote overwhelmingly for an organic-inorganic mixture. There is a strong case for reintroduction of some organic nitrogen in mixtures (1) to highlight the role of organic matter in preserving soil condition, (2) to make for sustained action of nitrogen, (3) to improve the physical condition of the mixture and (4) to eliminate filler, which, more than anything else, has tainted the image ot the mixture in the estimation of the public.

The providing of a percentage of organic nitrogen will constitute a distinctive feature of fertiliser mixtures and will make for their better acceptance. The ryot should have the freedom to buy his choice. If need be, let there be two classes of mixtures in approved categories : one with organic nitrogen and the other with its entire nitrogen in chemical form, and let the cultivator have his choice.

When all is said and done, most of our ryots are ignorant and open to exploitation. The average cultivator's requirements of nitrogen, phosphate and potash are small, and he will find it difficult, time-consuming and costly to buy

them in straight form in the quantities required by him. Even if he has the expert knowledge of compatibles to mix, the cost of ingredients, when bought in small quantities in open market, will equal or exceed the cost if bought in the form of ready-made mixture.

Suggestions

For an effective balanced fertilisation programme, the importance of the mixture manufacturer must be recognised. If this is not done, the problem of unbalanced and unscientific fertilisation will be aggravated especially with the introduction of the new liberalised marketing arrangements for straight fertilisers. The mixture manufacturers constitute a significant force working towards balanced fertilisation. To enable them function effectively, economically and with prestige, I would suggest the following :

(1) Government must hold the scales even between mixtures and straight fertilisers. There should be no insinuation against mixtures.

(2) Regardless of distribution policies of manufacturers, mixing firms must have access to supplies of chemical nitrogen in all forms, including complex fertilisers on equal terms. If necessary, Government should exercise the option to take over 30 per cent of production and make it available equitably to such mixing firms as are unable to get supplies from manufacturers direct. This will facilitate every fertiliser depot functioning as an emporium where all types of fertilisers would be available and the ryot can buy his choice. Incidentally, it will stop the pot calling the kettle black and confusing the customer.

(3) Government should issue regular registration certificates for mixtures conforming to approved analysis patterns, regardless of a portion of their nitrogen being provided in organic form. This will improve the physical condition of the mixture, eliminate filler and make for more durable action of the nitrogen.

(4) All fertiliser firms will do well to become members of the Fertiliser Association of India who will exercise sufficient vigilance to ensure that their members conform to a code of ethics and discipline, so as to project a respectable image of the mixture trade. The Fertiliser Association of India should make this possible by a suitable reduction of membership fee for new entrants.

(5) There should be a code of conduct in marketing. Nothing that will tarnish the image of the industry should be permitted at any marketing level.

(6) The Industry should be zealous of quality. The farmer buys on trust and judges quality in terms of results. If he finds himself cheated on harvesting the crop, he will be allergic to all products in its class.

(7) All fertiliser mixtures are made of ingredients which have suffered once sales tax. Therefore, Government should exempt fertiliser mixtures from sales tax.

THE TRENDS OF FERTILISER CONSUMPTION DURING RECENT YEARS IN RELATION TO THE CONSUMPTION OF DRY FERTILISER MIXTURES

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We find in recent years, a lot of changes in cropping pattern and fertilisation. High yielding varieties of paddy like IR 8, IR 5, Jaya and Padma are being introduced. Hybrid millets like different varieties of hybrid maize, hybrid jowar, and hybrid cumbu are being taken up for cultivation in more and more areas. Targets, for increasing the area under these varieties, are set by the Central and State Governments. These varieties require large amounts of N, P and K nutrients—three to four times more than ordinary varieties—to give higher yields.

We also find improved varieties of groundnut, sugarcane, tapioca and other crops, which are capable of giving higher yields when adequately fertilised. However, adoption of all these improved varieties by our cultivators depends on the price offered for these commodities and the net income they will be able to get to the cultivators.

We find changes in fertilisation of crops also. The change from organic to inor anic fertilisation has already occurred. Even with the inorganic fertilisation we find a steady and constant change. The application of farmyard manure, oilcakes, animal fleshings, etc., is replaced by ammonium sulphate and urea. Bone meal is replaced by superphosphate and complex fertilisers. The application of compost and wood ash is replaced by muriate and sulphate of potash. Fertiliser mixtures are being replaced by NPK complex fertilisers. The trend is towards applying concentrated high analysis fertilisers which are expected to be cheaper and quick-acting.

Consumption and targets of fertiliser nutrients

The consumption of N, P and K in India in 1968-69 stands at 12 lakh tonnes of N, 3 lakh tonnes of P and 1.6 lakh tonnes of K. The consumption in

the southern States was 3.7, 0.8 and 0.7 lakh tonnes of N, P and K respectively. The consumption of fertiliser nutrients during the period between 1963-64 and 1968-69 is given in Table 1.

TABLE 1

Consumption of Nutrients

(in '000 tonnes)

	1963-64	1964-65	1965-66	1966-67	1967-68	1968-69
INDIA						
N ...	426	492	582	830	1,156	1,222
P ...	121	149	134	275	447	296
K ...	51	75	90	134	206	164
SOUTHERN STATES						
N ...	174	207	213	371	454	366
P ...	54	60	63	99	185	80
K ...	33	46	53	72	91	67
TAMIL NADU						
N ...	47	79	71	95	149	98
P ...	11	16	17	36	66	19
K ...	12	16	18	29	45	25
ANDHRA PRADESH						
N ...	74	73	79	176	175	107
P ...	30	30	31	36	59	32
K ...	3	7	6	11	4	5
MYSORE						
N ...	25	32	31	50	87	103
P ...	10	10	10	19	46	20
K ...	8	9	8	13	21	12
KERALA						
N ...	12	9	8	29	26	32
P ...	3	4	4	8	12	8
K ...	10	13	21	19	20	25

The targets to be achieved in 1973–74 in India to produce the required grains and other agricultural products are 37.5 lakh tonnes of N, 17.4 lakh tonnes of P and 11.1 lakh tonnes of K—little more than 3 times the actual consumption in 1968-69 in the case of N, 6 times in the case of P and 7 times in the case of K.

An analysis of the consumption of N, P and K in India from the year 1963–64 to 1968–69 would show a steady increase in the consumption of all the nutrients until 1968–69. There is reduction in the consumption of P and K in 1968-69.

In the southern States we find a steady increase in the consumption of N, P and K till the year 1967–68 and a drop in the consumption of all nutrients in the year 1968–69. We find a drop in the consumption of all nutrients in Tamil Nadu, N and P in Andhra Pradesh, P and K in Mysore State and P only in Kerala. This reduction is largely due to the failure of monsoons in the southern States in 1968–69 and the heavy imports in 1967–68.

Consumption of nutrients per unit crop area

The steady increase in the consumption of nutrients is not only due to the additional areas brought under cultivation and under irrigation but also due to the increased consumption per unit area. The per hectare consumption of nutrients increased from 2.17 kg. in 1961–62 to 6.88 kg. in 1966–67 in India and in the southern States from 4.60 to 14.38 kg. during the same period. The per hectare consumption of nutrients during the period between 1963–64 to 1968–69 is given in Table 2.

TABLE 2

Consumption of Nutrients per Unit Crop Area

(in kg. per hectare)

	1963-64	1964-65	1965-66	1966-67	1967-68	1968-69
INDIA						
N ...	2.51	2.81	3.32	4.71	6.40	7.00
P ...	0.72	0.85	0.77	1.51	2.47	1.69
K ...	0.30	0.42	0.51	0.76	1.16	0.94
Total ...	3.53	4.08	4.60	6.88	10.03	9.63

Table 2 Continued) (in kg. per hectare)

	1963-64	1964-65	1965-66	1966-67	1967-68	1968-69
OUTHERN STATES						
N ...	4.85	5.55	5.66	9.84	11.64	9.78
P ...	1.51	1.61	1.66	2.62	4.68	2.13
K ...	0.90	1.22	1.41	1.92	2.42	1.80
Total ...	7.26	8.38	8.73	14.38	18.74	13.71
AMIL NADU						
N ...	6.23	10.00	8.94	12.22	19.05	12.45
P ...	1.45	2.0.	2.16	4.61	8.46	2.43
K ...	1.54	2.03	2.30	3.74	5.74	3.13
Total ...	9.22	14.04	13.40	20.57	33.25	18.01
ANDHRA PRADESH						
N ...	5.46	5.08	5.53	12.38	11.23	7.56
P ...	2.19	2.10	2.15	2.52	3.57	2.27
K ...	0.11	0.18	0.40	0.74	0.29	0.34
Total ...	7.76	7.36	8.08	15.64	15.09	10.17
MYSORE						
N ...	2.00	2.54	2.42	3.89	6.76	8.22
P ...	0.80	0.76	0.79	1.49	3.65	1.59
K ...	0.57	0.72	0.62	1.02	1.66	1.00
Total ...	3.37	4.02	3.83	6.40	12.07	10.81
KERALA						
N ...	4.71	3.31	3.06	10.83	9.55	11.33
P ...	1.32	1.43	1.62	2.83	4.29	2.82
K ...	3.99	5.01	7.95	7.19	7.32	8.76
Total ...	10.02	9.75	12.63	20.85	21.16	22.91

However, when we compare this with those of other countries in the world, we stand among the last few countries. Japan, which produces the largest quantity of rice in an unit area, for example, consumes 35 times more of nutrients than our consumption level.

This shows that we still have the potential to increase the consumption of fertilisers per unit area. The targets set are not unrealistic, provided we create other conditions congenial for increasing the consumption.

Table 3 illustrates the consumption of fertilisers and production of rice, wheat and corn per unit area in some of the leading countries in the world, compared to our country.

TABLE 3

Consumption of Fertilisers and Production of Rice, Wheat and Corn

Country	Consumption in kg. per hectare				Yield in kg. per hectare		
	1966-67				1966-67		
	N	P	K	Total	Rice	Wheat	Corn
WORLD ...	13.8	10.8	9.0	33.6	20.0	14.2	23.3
U.S.S.R. ...	11.0	6.9	7.9	25.8	28.7	14.4	26.1
W.GERMANY..	108.0	96.2	130.9	355.1	...	32.6	...
FRANCE ...	48.2	66.5	49.9	164.6	...	28.3	45.0
U.A.R. ...	89.9	19.8	0.4	110.1	41.2	26.8	35.7
JAPAN ...	141.8	105.1	106.7	353.6	50.9	24.3	...
CANADA ...	5.8	8.6	3.7	18.1	...	18.7	...
U.S.A. ...	30.5	21.8	10.3	70.0	48.5	17.7	45.4
AUSTRALIA ...	2.3	26.4	2.1	30.8	69.7	15.3	22.5
INDIA ...	5.1	1.7	0.8	7.6	12.8	8.2	9.9

Consumption ratio of nutrients

When we look into the ratio of consumption of N, P and K, we find that in most of the leading countries these nutrients are consumed in the ratio of 1 : 1 : 1 whereas in India the consumption is in the ratio of 1 : 0.39 : 0.18. Table 4 gives the ratio of consumption of N, P and K in some of the leading countries in 1966–67.

TABLE 4

Ratio of N, P and K Consumption

Country	N	P	K
WORLD (excluding mainland China) ...	1.0	0.8	0.7
BELGIUM	1.0	1.0	1.2
JAPAN	1.0	0.6	0.6
W. GERMANY	1.0	1.0	1.3
FRANCE	1.0	1.5	1.0
U.S.A.	1.0	0.6	0.3
SPAIN	1.0	0.6	0.2
AUSTRALIA	1.0	10.0	1.0
U.S.S.R.	1.0	0.7	0.7
CANADA	1.0	1.0	0.5
INDIA	1.0	0.3	0.2

Table 5 gives details of the ratio of consumption of N, P and K in India and in the individual States of Tamil Nadu, Andhra Pradesh, Mysore State and Kerala. You will find that the consumption of P and K is steadily increasing till the year 1967-68 and in 1968–69 the consumption of P and K is reduced, except in Kerala and Andhra Pradesh where a small increase is noticed in the case of K.

Even though there is a general reduction in the consumption of N, P and K in the southern States in the year 1968–69 due to adverse seasonal conditions, there is no reason why the reduction in the consumption of K is much more than the

reduction in the consumption of other nutrients. The reduction in P can, however, be explained by the large imports of diammonium phosphate in 1967–68.

TABLE 5

Consumption Ratios of N, P and K in India and in the Southern States

(in kg. per hectare)

		1963-64	1964-65	1965-66	1966-67	1967-68	1968-69
INDIA	N	...	1.00	1.00	1.00	1.00	1.00
	P	...	0.30	0.23	0.33	0.39	0.24
	K	...	0.15	0.15	0.16	0.18	0.13
SOUTHERN STATES	N	...	1.00	1.00	1.00	1.00	1.00
	P	...	0.29	0.29	0.27	0.40	0.22
	K	...	0.22	0.25	0.20	0.20	0.18
TAMIL NADU	N	...	1.00	1.00	1.00	1.00	1.00
	P	...	0.20	0.24	0.38	0.44	0.19
	K	...	0.20	0.26	0.31	0.30	0.25
ANDHRA PRADESH	N	...	1.00	1.00	1.00	1.00	1.00
	P	...	0.41	0.39	0.20	0.32	0.30
	K	...	0.04	0.07	0.06	0.02	0.05
MYSORE	N	...	1.00	1.00	1.00	1.00	1.00
	P	...	0.30	0.33	0.38	0.53	0.19
	K	...	0.28	0.25	0.26	0.25	0.12
KERALA	N	...	1.00	1.00	1.00	1.00	1.00
	P	...	0.44	0.53	0.26	0.45	0.25
	K	...	1.51	2.60	0.66	0.77	0.77

The ratio of the consumption of N, P and K, even though it has been converging towards 1 : 1 : 1 till 1967-68, has, in the year 1968-69, begun to diverge due to the disproportionate low consumption of K particularly in Tamil Nadu and Mysore State.

Consumption of fertiliser meterials

Table 6 gives details of consumption of straight fertilisers, complex fertilisers and fertiliser mixtures in the year 1963-64 to 1968-69 in India and the southern States. We find a steady increase in the case of the nitrogenous fertilisers, ammonium sulphate and urea, in India. In the southern States, however, the consumption of ammonium sulphate has showed a declining trend from the year 1967-68 onwards for obvious reasons, whereas the consumption of urea has showed a steady increase.

The consumption of NP and NPK complex fertilisers has shown a tremendous growth in the recent years.

It is interesting to note that 75 per cent of the consumption of fertiliser mixtures in India is consumed in the southern States. The consumption of these dry mixtures has shown a steady growth till 1966-67 and thereafter started declining rapidly. The decline coincides with the remarkable increase in the consumption of NPK complex fertilisers and urea in 1967-68. An analysis of Table 6 would indicate the following :

(1) There has been a steady growth in the consumption of N, P and K in India and in the southern States till 1967-68. The consumption was, however, less in the year 1968-69 in the southern States mainly due to adverse seasonal conditions.

(2) The consumption of N, P and K is converging into the ratio of 1 : 1 : 1. This ratio is found in the developed countries of the world where larger crop production is noticed. This trend was, however, disturbed during the last few years when large-scale introduction of NPK complex fertilisers and urea, particularly in the southern States, had taken place.

(3) Fertiliser mixtures largely contributed towards balanced fertilisation in the southern States and the consumption of the fertiliser mixtures started declining with the introduction of NP and NPK complex fertilisers.

TABLE 6

Consumption of Different Types of Fertilisers

(in '000 tonnes)

	1963-64	1964-65	1965-66	1966-67	1967-68	1968-69
INDIA						
Ammonium sulphate ...	821	925	1450	1387	1373	1669
Urea	262	334	297	643	1095	1290
NP/NPK complex ...	94	126	168	547	990	649
Mixture	591	794	771	973	898	753
Superphosphate	646	784	637	717	800	651
Potassic fertiliser ...	86	128	150	225	319	264
SOUTHERN STATES						
Ammonium sulphate ...	260	361	476	592	537	579
Urea	165	215	161	369	462	453
NP/NPK complex ...	73	87	133	256	527	301
Mixtures	...	519	512	684	635	549
Superphosphate	246	268	224	251	262	215
Potassic fertiliser ...	54	75	89	123	129	112
TAMIL NADU						
Ammonium sulphate ...	68	95	172	111	167	124
Urea	61	113	59	112	159	183
NP/NPK complex ...	29	31	34	78	214	100
Mixture	194	276	257	381	326	301
Superphosphate ...	50	62	65	89	65	45
Potassic fertiliser ...	20	27	30	49	55	42

(*Table 6 Continued*) (in '000 tonnes)

	1963-64	1964-65	1965-66	1966-67	1967-68	1968-69
ANDHRA PRADESH						
Ammonium sulphate ...	82	126	136	306	176	196
Urea	68	58	69	162	191	90
NP/NPK complex ...	46	61	42	67	75	13
Superphosphate	129	134	88	76	110	92
Potassic fertiliser ...	5	14	10	19	5	7
MYSORE						
Ammonium sulphate ...	28	67	70	74	103	166
Urea	26	33	20	55	80	143
NP/NPK complex ...	6	6	12	36	113	69
Mixture	48	70	93	111	91	86
Superphosphate	52	55	49	61	67	61
Potassic fertiliser	13	16	13	22	33	27
KERALA						
Ammonium sulphate ...	26	15	14	52	43	43
Urea	7	7	6	31	27	30
NP/NPK complex ...	5	5	5	18	26	29
Mixture	90	94	104	124	142	147
Superphosphate	15	17	21	23	20	17
Potassic fertiliser ...	17	22	36	33	34	36

Fertiliser mixtures as a top-dressing fertiliser

Fertiliser mixtures are largely used as top-dressing fertilisers. With the introduction of complex fertilisers, the tendency of cultivators is to apply urea as

top-dressing fertiliser. This has, therefore, replaced fertiliser mixtures and, with the increased availability of complex fertilisers and urea in the coming years, the consumption of NPK dry mixtures is expected to go down further. With the mixtures going out, the nutrients P and K are not provided to crops on top, as N alone in the form of urea takes its place.

NK mixtures for top-dressing paddy

Paddy in the southern States is grown in more than 70 per cent of the gross irrigated area and high yielding varieties are fast taken up for cultivation. These varieties are expected to replace the present types in a few years' time.

Experiments conducted in India and abroad have proved beyond doubt that split application of N and K after planting increases yields in paddy. The recent trials and demonstrations conducted by the Indian Potash Supply Agency Limited prove that application of NPK in the base and NK on top has increased paddy yields from 6 to 29 per cent over application of N only on top and NPK at the base. A yield of 6244 kg. of paddy was obtained by Mr. Y. Narayanaswami of Poonthottam village in the Coimbatore district of Tamil Nadu from an acre of IR 8 paddy by applying 35 kg. of N, 35 kg. of P and 35 kg. of K as basal dressing with 15 : 15 : 15 complex fertiliser and 40 kg. of N and 40 kg. of K as top-dressing in two doses. This plot on the whole received fertilisers at 75 kg. of N, 35 kg. of P and 75 kg. of K per acre.

Another demonstration trial conducted in Ganjam district on IR 8 paddy showed that application of N and K at 23 and 18 kg. per acre in two doses has increased the yield by 27 per cent. A similar trial conducted at Sambalpur has shown an increased yield of 48 per cent in the case of IR 8 and 55 per cent in the case of TN 1 paddy.

Soil fertility maps prepared by the Soil Test Crop Response Correlation and Co-ordination Unit of the Indian Agricultural Research Institute indicate that the soils of the southern States, except in few patches, have only a low or medium content of the three major plant nutrients. The entire Kerala and most of Andhra Pradesh and Tamil Nadu have a low K content.

All these findings show the necessity of applying N and K in one or more doses after planting in the case of high yielding varieties of paddy, millets and other K loving crops like banana over the basal application of NPK.

The indigenous production of NPK complex is expected to go up when the plants in the southern States commence their production in a year or two. More factories, namely, Madras, Tuticorin, Mangalore, Goa, and Ramagundam are expected to produce NPK complex and urea during the Fourth Five Year Plan period.

The tendency of a cultivator will be to apply urea on top and be satisfied with it as he will find the greening and the growth. He will not be able to know the unbalanced fertilisation and the reduced yield created by not providing K with N.

You will find from Table 6 that the southern States consume 6 lakh tonnes of fertiliser mixtures which are mostly NPK combination. The replacement of the mixtures with NPK complex and urea denies application of K on top and this will certainly result in unbalanced fertilisation to high yielding varieties of paddy and other K loving crops and reduced yields.

It is, therefore, of paramount importance that we should educate the ryots in the use of N and K on top either in straight form or as NK mixture. As the size of our holdings is very small, it might be easier for the cultivator if these nutrients are provided in the form of mixtures of different combinations suitable for different areas and crops.

For example, let us assume that a farmer cultivating half an acre of IR 8 will have to apply 35, 17.5 and 35 kg. of N, P and K. He may apply 17.5 kg. of N, 17.5 kg. of P and 17.5 kg. of K as NPK complex. The balance 17.5 kg. of N and 17.5 kg. of K can be applied either as 38 kg. of urea and 30 kg. of muriate of potash or as a mixture in two doses. It might be easier for him to apply a bag of 40 kg. of NK mixture instead of going in separately for urea and muriate of potash and the extra cost he may have to pay per bag of mixture towards mixing, bagging and other services will be negligible.

It will be in the interest of urea manufacturers to see that urea goes with potassic fertilisers so that the farmers may obtain maximum yields. The Indian Potash Supply Agency Limited should also see that potassic fertilisers are applied along with nitrogenous fertilisers particularly in the case of crops which require K on top.

You will, therefore, agree that the existing standard mixtures of NP, NPK and NK should be revised and the list of standard mixtures should contain mostly NK mixtures of different grades.

It is therefore necessary in the interest of all concerned—the farmers, manufacturers of nitrogenous fertilisers, marketers of potassic fertilisers, and fertiliser mixture manufacturers that NK mixtures are introduced quickly and popularised.

Suggestions

May I therefore suggest the following for achieving the objective of balanced fertilisation and increased yields of crops :

(1) The Fertiliser Association of India, Southern Region, is to approach the State Governments for conducting fertiliser workshops to decide on the nutrient requirements of different crops under the existing soil conditions and cropping patterns.

(2) The present grades of standard mixtures are to be modified suitably after taking into consideration the grades of NP and NPK complex fertilisers produced in the southern States and imported and seeded at present.

(3) There should be different grades of NK in the ratios of 4 : 0 : 3, 2 : 0 : 1, 1 : 0 : 1, 1 : 0 : 2, 1 : 0 : 3 to fit in the requirements of different crops.

(4) The Fertiliser Association of India, its members and the Indian Potash Supply Agency Limited should demonstrate the benefits of NK mixture over NPK complex applied in the base. The manufacturers of NPK complex and urea and the Indian Potash Supply Agency Limited may supply, free of cost, fertilisers for demonstrations as such demonstrations will popularise their products also.

(5) All other conventional methods of advertisement and propaganda should be undertaken quickly to make the cultivators NK mixture-minded during this transitional period.

CRISIS IN THE FERTILISER MIXTURE TRADE IN TAMIL NADU

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Modern techniques in agricultural production have convinced the Indian farmer that better yields are obtainable by their adoption. Judicious and balanced application of fertiliser nutrients is found to be the most important of these techniques. The provisions in the Fertiliser (Control) Order cover in essence the aspect of quality control and a suitable provision for the protection of the trade has not yet been introduced.

It took nearly twenty years for the Government, both at the Centre and in the States, to educate the farmer that fertiliser inputs alone will enhance the crop outputs. The steady progress of fertiliser consumption in the southern States, especially in Tamil Nadu, during the last eight years is noteworthy. The fertiliser industry till recently had the advantage of a sellers' market and the firms dealing in fertilisers apparently had the guidance and help from the Government. The farmers who were pessimistic about the improved methods of agriculture two decades ago have now become optimistic about the use of fertilisers, improved seeds, improved cultural methods and pest control methods.

The field experiments on fertilisers were first conducted in all the States under the auspices of the Indian Council of the Agricultural Research. The Tamil Nadu Agricultural Department started conducting experiments on the suitability of fertilisers and on the nutrient requirements of different agricultural crops from 1960 and arrived at definite grades of NPK mixtures keeping in their mind the value of balanced application of nutrients for every crop. The Department of Agriculture introduced standard NPK mixtures for all crops. Due to propaganda both by the Government and the fertiliser mixing firms through their agents and dealers, the farmers became mixture-minded within a period of three years.

Decline in the fertiliser mixture trade

We have had a pernicious drought during the last two years and the farmers had to fight against the vagaries of the monsoons. With the easy

availability of fertilisers, the fertiliser market has become a buyers' market. In addition to these the ushering in of complex and compound fertilisers, the towering cost of fertilisers and the un sound economic position of the farmer have greatly affected the NPK mixture trade.

The farmers, especially the poor class which forms the major portion of the agricultural population, have no means to purchase balanced fertilisers at present. They prefer straight fertilisers, chiefly nitrogenous which generally exhibit an ocular improvement in the stand of the crop.

The fertiliser mixture trade is on the road leading to extinction. The present position of the trade is so precarious that timely action of the Government in coming to the rescue of the small mixing firms, which are about 140 in Tamil Nadu, will certainly contribute in a big way in maintaining the principle of delivering balanced standard mixtures to the farmers.

The difficulties of small mixing firms

The mixing firms have invested sizeable amounts of money in their business expecting adequate return. In their effort to popularise standard mixtures they have also advanced credit to farmers during the past several years resulting in large amounts of outstandings.

Under the Intensive Manuring Scheme loan permits for fertilisers are issued to farmers enabling them to get fertilisers only from such mixing firms which have lifted at least 200 tonnes of diammonium phosphate from the Government stocks, the cost of which is Rs. 2 lakhs. In addition to this N and P will be required which will cost another Rs. 2 lakhs. It will be very difficult for the small mixing firms at present to raise this amount especially when they had very little business during the last two years. These small firms, who have been doing yeoman service, will have no revival unless the Board of Revenue of the Tamil Nadu Government kindly revise their stand.

The diammonium phosphate which is stocked in Government godowns should be correctly analysed for N and P. This measure is indispensable because during the long storage they would have become substandard. The Government should itself set an example as regards quality control. After deciding the percentages of N and P, price must be fixed on the basis of unit values. The cooperatives who have stocked this valuable diammonium phosphate should also do likewise. It is also necessary that the Board of Revenue, when they allot

rtilisers to mixing firms, kindly notify the percentages of nutrients in the fertilisers they allot. Otherwise, it will be hard for the mixing firms to be responsible for the quality of mixtures.

There are huge stocks of diammonium phosphate lying with the Government. The mixing firms may be allotted such quantities which will be intimated by the panchayat unions to their respective Collectors who in turn intimate to the Board of Revenue who then will allot the diammonium phosphate to the different firms on letter of credit basis. The mixing firms, after making the required standard mixtures, must deliver the mixtures to the respective panchayat unions and the cooperatives to the value of loan permits issued under the Intensive Manuring Scheme. Only by such mutual help, the Government and the cooperatives can easily dispose off their stocks of fertilisers.

The tug between the complex fertilisers and the standard mixtures has reached such a stage as to eclipse the latter which are products of long years of scientific research. The sudden emergence of the complex has created a new situation for the small mixing firms. Likewise, the superphosphate industry is suffering. The impact of complex fertilisers on the manufacture of superphosphate has been such that the price level of superphosphate fell from Rs. 475 per tonne to Rs. 350. Does not the superphosphate industry deserve protection? The enormous capital invested in machinery, staff, buildings and labour seems to have very little earning capacity. Consequently, the availability of superphosphate for manufacturing standard ixtures will be seriously affected. Superphosphate is perhaps the cheapest ource of P that the mixing industry can have.

It is not my intention to decry the high analysis complex mixtures, as they have a large theoretical importance in the present context. The compound and complex fertilisers have their own advantages and disadvantages.

dvantages of complex fertilisers

(1) Complex fertilisers are cheaper than the standard mixtures. My experience with complex fertilisers tells me that the NPK complex 28 : 28 : 0 is quite economical and handy for application. But the farmer may not care to balance and apply.

(2) Granulation is ideal for drilling the fertiliser in the soil for even distribution. But the practice of drilling is not usual in Tamil Nadu. Granulation has not reached a stage of perfection. One could see that the

granules are not of uniform state or size and thus there is bound to be an appreciable variance in the density of the granules. Broadcasting will result in uneven distribution.

(3) Being of higher nutrient content, the cost of transport, distribution and application to crop is much reduced.

Disadvantages of complex fertilisers

(1) The disadvantage of using compound and complex fertilisers as compared to balanced fertiliser mixtures is that the ratio of the component nutrients in compound or complex fertilisers is fixed and it may have to be adjusted by addition of single-nutrient fertilisers to conform to the proportion of nutrients needed. Hence they are indirectly costlier.

(2) Compound and complex fertilisers contain plant nutrients in fixed proportions and are therefore not always best adapted to different kinds of soils. Accordingly, the needs of different soils can only be met more economically by the use of standard fertiliser mixtures containing two or more nutrients in suitable proportions and these are complete fertilisers having been properly balanced.

(3) The complex fertilisers are mostly the products of trade and lack experimental background. They are not based on large-scale trials and demonstrations done in cultivators' fields. The question has often been posed as to how many grades of complex and compound fertilisers should be manufactured in the country, considering the present state of our knowledge of crop responses to fertiliser application.

Standard mixtures *versus* complex fertilisers

The service rendered by the mixing firms and the State Governments over the past few decades has made the farmer both fertiliser and mixture-minded. It will be a wasted effort if the mixture trade is not sustained. The standard mixtures have been formulated after long research by the Agricultural Department to suit all soils and all agricultural crops. Above all, they are efficient. They are best suited to supply different nutrients to the crops to the limits advocated by the Agricultural Department. Complex fertilisers could never by themselves supply the prescribed nutrients to all crops. The standard mixtures have the unique superiority over complex fertilisers in containing micronutrients. For instance,

magnesium in dolomite is very useful for chlorophyll formation. Micronutrients can easily be introduced in mixtures.

By the introduction of new fertilisers, the farmers get confused and our achievements in food production get retarded. The farmers are used to the standard mixtures for long years and anything new would certainly confuse them.

It is easier to apply standard mixtures more evenly as they are required in larger quantities than complex fertilisers for an acre of crop.

Rehabilitation of the mixture trade

(1) The level of unit prices of nutrients both in the standard mixtures and complex fertilisers should be the same and not varying. This deserves the attention of the Government.

(2) The propaganda of Agricultural Department through radio in the rural programmes at present is more for application of complex and straight fertilisers. The farmer is not accustomed to applying fertilisers twice or thrice because they entail more expenditure on labour. He should be advised to apply the total quantity of standard mixture as basal dressing.

(3) The soils are prone to show residual effects of phosphoric acid. Any more addition of phosphoric acid to soil through the complex fertilisers may be responsible for encouraging virus diseases. This should be studied in detail.

(4) The authorities should be advised to issue loan permits under the Intensive Manuring Scheme to farmers in favour of private trade also thus enabling the farmers to get thier requirements of fertilisers from dealers of their choice. The loanees should be able to exercise their option of getting any brand of fertiliser mixtures they like.

(5) The fertiliser stocks in Government godowns, whether old or new, must be analysed for N and P content before they are sold. The price of fertiliser should be fixed as per nutrient content to facilitate maintenance of quality control.

Conclusion

I wish to point out that there are many factors responsible for higher yields. Science has established the fact that it is not plant foods alone which are mainly

responsible for better crops. Sunlight, percentage of carbon dioxide in the atmo sphere, beneficial bacteria both in the soil and the plant capable of fixing nitrogen as well as manufacture of nitrates in plant body, micronutrients and certain algae in ri e fields such as blue-green algae are all responsible for high yields in paddy. The problem before the scientist is to see how supply of N could be minimised. The International Rice Research Institute in Philippines and the Central Rice Research Institute in Cuttack are doing research in these directions. The importance of having o ganic N which will be useful not only for the crops but also for the bacterial growth has been omitted in our schedules. It is high time we think of re-introducing organic N in the form of bone meal in standard mixtures along with micronutrients to make the standard mixtures most effective. The researcher is requested to bear in mind that profuse supply of nutrients such as N and P is responsible for the increase of pests and diseases in crops. Our aim should be to increase the yields.

QUALITY CONTROL, STORAGE AND BALANCED FERTILISATION IN RESPECT OF MIXED FERTILISERS IN TAMIL NADU

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Quality control

It may be recalled at the outset that quality control on fertilisers is not new to Tamil Nadu. This State was ahead of other States in the Indian Union in taking appropriate steps to prevent the sale of spurious fertilisers and ensuring quality in fertilisers, both straight and mixed, so that the cultivators could get a fair deal. The Madras Manure Dealers Licensing Order and the Madras Manure Mixtures Quality and Price Control Order were in force in the undivided State of Madras during the years 1948 to 1953. Following the decontrol of food grains, these regulations were annulled in January, 1953.

The Fertiliser (Control) Order was introduced in this State in August, 1957. The Fertiliser (Control) Order primarily aims at prohibiting manufacture, sale and distribution of spurious and substandard fertilisers. It also arms the Government to fix the maximum ceiling price for fertilisers to ensure supplies at a reasonable price to the cultivators. The requirement of a guarantee for the quality of a fertiliser under the Fertiliser (Control) Order not only protects the farmers, but also helps to protect those manufacturers who are attempting to conduct their business on a high ethical plane.

The conditions that prevailed a decade back, when the farmers were ignorant of the use of fertilisers and there were only a few distributors of fertilisers, are no more applicable. Now the farmers are enlightened about the efficacy of fertilisers. The rubber plantations under the control of the Forest Department prescribe special mixtures that are required for their rubber plantations to contain even secondary nutrients like magnesium. In the Nilgiris district, the blue-gum and wattle plantations also get special mixtures through the Forest Department. The Forest Department also prescribes NPK standard mixtures like 9 : 9 : 9 for cashew

plantations in South Arcot, Tiruchirappalli and Chingleput districts. The coffee and tea plantations are now being manned by qualified professional men only. The fertiliser industry which had a sellers' market in the past has now become a buyers' market and the consumer can pick and choose the best quality fertiliser.

Manufacturers usually have their own laboratories to test the quality of their products and take corrective action at the production stage to ensure that only quality products are released from the factory. The medium and small manure mixing firms also get the raw materials tested for the guarantee either at the Government or private laboratories before making use of them in the manufacture of mixed fertilisers. The cooperative societies and other manure mixing firms also carry out test checks for their standard mixtures either in the Government institutes or private laboratories.

In Tamil Nadu, there are 40 District Agricultural Officers, 5 Regional Deputy Directors of Agriculture, 375 Agricultural Extension Officers and 5 Regional Fertiliser Inspectors attached to each Regional Deputy Director of Agriculture and, all of them are empowered to take fertiliser samples from mixing centres and manure dealers. When the Fertiliser (Control) Order was introduced in the year 1957, there were only 20 manure mixing firms and now the number has expanded to 136 with over 7,000 dealers for retail sale. These figures indicate the necessity of collecting large number of fertiliser samples for test check for quality. At the commencement of quality control in fertilisers in 1957–58, only 90 samples were collected and analysed. But in the year 1968–69, the number has increased to 1,404 samples. Even this number is meagre when the number of mixing firms and the total production are taken into consideration. The collection of samples has now been restricted to about 150 samples per month, the present capacity of the laboratory. Hence, the District Agricultural Officers have been instructed to take only 2 samples in their jurisdiction and the specially appointed Fertiliser Inspectors at the rate of 15 samples per month. This restriction has been imposed as only one unit for chemical analysis is now functioning with 5 Analytical Assistants and one Assistant Agricultural Chemist to guide and supervise the work. There is an absolute need for strengthening the quality control laboratory as free trade of fertilisers has been permitted now. Even if 2 samples per month are drawn by the staff engaged in the Agricultural Department from each panchayat union, it will exceed 750 samples per month whereas the facility exists only for 150 samples at present.

The Government of India has recently instructed all the State Governments

strengthen the quality control laboratory and commended the work done in mil Nadu. The other States have been instructed to follow the example of mil Nadu. It is proposed to set up another unit in Tamil Nadu at the Madurai gricultural College with 3 Analytical Assistants and one Assistant Agricultural hemist to cope up with the increased receipt of samples from the southern districts nd for the timely conduct of analysis.

In the existing laboratory at the Agricultural College and Research Institute, Coimbatore, so far 6,357 fertiliser samples were received for chemical analysis from the time of inception of the Fertiliser (Control)Order. Out of this 1,083 samples were discarded for want of certain essential details like the packing slip. The remaining 5,274 samples were analysed and results reported. Out of 5,274 samples analysed 3,278 samples were found to conform to the guaranteed analyses and the remaining 1,996 samples were found to be deficient in one or more nutrients. In most of the cases, the deficiency was only in water-soluble phosphate content due to the chemical interaction of the ingredients used in the manure mixture and reversion of phosphate. At the request of the Fertiliser Advisory Committee, in March 1965, that water-soluble phosphate and citrate-soluble phosphate should be taken for the guaranteed analysis of water-soluble phosphate in a mixed fertiliser, storage trails were conducted on mixed fertilisers at the Agricultural College and Research Institute, Coimbatore. The details are furnished in the subsequent portion of this paper. Since February, 1967, whenever any deficiency was noticed in the water-oluble phosphate content, estimations for citrate-soluble phosphate were also arried out to account for the reversion of phosphate if any.

Further, in the year 1968, a tolerance limit of 5 per cent of the guaranteed nalysis was permitted for the ungranulated physical manure mixtures. The eficiency may be either in one nutrient or in all nutrients, subject to the maximum of 5 per cent of the total guaranteed analysis. This has resulted in considerable reduction in the fertiliser samples not analysing to standards. In the year 1968-69, in all 921 samples were analysed and only 82 samples were found to be substandard. It can be proudly stated here that the cultivators are getting the best quality fertilisers in Tamil Nadu as long as they purchase from a licensed manure dealer.

Sampling

In the quality control of fertilisers, the scale of sampling, the method of drawal of samples, the mode of despatch of samples and the method of analysis are the essential criteria in assessing the quality of a fertiliser.

With regard to the scale of sampling there are differences between the scales prescribed by the Fertiliser (Control) Order and the Indian Standards Institution. The details are given in Table 1. The scale of sampling prescribed by the Indian Standards Institution can be recommended for acceptance by the Government as it is easy for adoption.

TABLE 1

Scale of Sampling

Fertiliser (Control) Order		Indian Standards Institution	
Lot size	Number of samples to be drawn per lot	Lot size	Number of samples to be drawn per lot
2-8	2	0-100	5
9-27	3	101-300	6
28-64	4	301-500	7
65-125	5	501-800	8
126-216	6	801-1300	9
217-343	7	1301 and above	10
344-512	8		
513-729	9		
730-800	10		

As regards drawal of samples it should be done by qualified and trained persons. To safeguard the interests of the consumers, it is essential to draw samples at the retail points. Samples may be drawn with an appropriate sampling instrument. If the containers do not permit the use of sampling instruments, then empty the contents of the container on a level, hard, clean surface and draw sample by the quartering method.

The mode of despatch is also important. The sample should be sent within seven days from the date of drawal, with a packing slip inside and outside the container furnishing the name of the fertiliser, the date of drawal of the sample and the date of despatch with the name of the office sending the sample. The

container should be completely filled and properly sealed. The containers are tightly bound with twines and stamped with the seal of the Inspector. Here it is also stressed that the sample should be sent in code words without revealing the name of the manufacturer or the dealer of the fertiliser and there must be distinguishing marks if there is more than one sample in a particular grade. Otherwise, the purpose of sampling and chemical analysis is defeated. The above three items of work require certain amount of training to the staff collecting the sample for analysis. It is desirable that the retail dealers also know the correct method of sampling so that they can be sure that there is no error in the sampling techinque. This can be achieved by issuing printed instructions to the retail dealers by the concerned manufacturers and demonstrating the sampling technique in their mixing yards. Besides, the manufacturer can also insist that his dealers issue a quality certificate to the purchasers along with the bill of sale, so that the responsibility for sub-standard, if any, can be fixed on the dealer.

Standardisation of analytical methods

The next and the most important aspect is the standardisation of analytical methods. Laboratories equipped for analysing fertilisers are very few in the country. Analysis of fertiliser sample is a time-consuming process. At present, the results are communicated within 60 days from the date of drawal of sample. The values of analyses for a particular sample may vary between laboratories, between two chemists in the same laboratory and between the duplicates conducted by the same chemist.

The differences can be attributed to the differences in the method of analysis, accuracy of the particular method and the experience of the analyst. In the chemical analysis, the analytical method which gives the minimum deviation can be considered as the best. Laboratories with the fertiliser firms, the Government, and the agricultural colleges should co-ordinate in this activity.

An attempt was made in the year 1965 to compare the results of chemical analysis obtained at the Agricultural College and Research Institute, Coimbatore, and at the Indian Agricultural Research Institute, New Delhi. A similar attempt was also made in 1968 at Coimbatore to compare the results obtained at the Agricultural College and Research Institute and the laboratory of a local leading manure mixing firm. Attempts were also made to exchange the samples between the States to compare the results. The Indian Standards Institution has also made certain attempts in this direction. Though the type of evaluation is time-consuming, the results can be checked for their repeatability and dependability.

The fertiliser analytical chemists of the various agricultural colleges, the fertiliser industry, the registered analytical laboratories and the Indian Standards Institution should meet at least once in a year to focus on the standardisation of analytical methods and adopt uniform procedures in all the fertiliser quality control laboratories.

Storage studies on mixed fertilisers

The quality of mixed fertilisers sometimes suffers due to faulty mixing and also due to unfavourable physical and chemical changes of the materials in the mixture during storage. In the case of fertiliser mixtures containing urea, superphosphate and fillers like gypsum, it has been observed that there is reduction in water-soluble phosphate on storage.

A laboratory study was undertaken with the mixtures of urea, superphosphate and gypsum with and without potassium chloride. The two NPK mixtures contained nutrients in the ratio of 12 : 6 : 0 and 12 : 6 : 6 respectively. The mixtures were stored in polythene-lined jute bags and kept for a period of six months from September, 1964 to February, 1965. Samples were drawn at one month interval periodically and analysed for total nitrogen, total phosphate, water-soluble phosphate and total potash.

The results of the studies, indicated in Table 2, show that moisture increases rapidly by 30th day of storage and thereafter progressively. Potassium chloride has no effect on moisture absorption. The decrease in water-soluble phosphate and citrate-soluble phosphate is more than the reversion of citrate-soluble phosphate to insoluble form. The reversion of water-soluble phosphate to citrate-soluble phosphate appears to occur through the formation of urea phosphate and bimolecular reaction. Superphosphate mixed with urea reduces the critical relative humidity and enhances the moisture absorption by urea. The rate of reversion is not influenced by the addition of potassium sulphate indicating that the reversion mainly takes place at homogenous reaction phase consisting of saturated liquid phase created by the absorption of moisture. There are good evidences for the formation of urea phosphate at temperatures above 30°C and relative humidity 64.5 per cent which hastens the reversion of water-soluble phosphates. The reactions involved are :

$$Ca(H_2PO_4)H_2O \rightleftharpoons CaHPO_4 + H_3PO_4 + H_2O$$

$$H_3PO_4 + CO(NH_2)_2 \longrightarrow CO(NH_2)_2 + H_3PO_4$$

$$Ca(H_2PO_4)_2H_2O + CO(NH_2)_2 \longrightarrow CaHPO_4 + CO(N_2H_2H_3)PO_4 + H_2O$$

5-a

The reversion of citrate-soluble phosphate to insoluble condition takes place slowly and is not a problem during storage.

TABLE 2

Storage Study on Mixed Fertilisers with and without Potassium Chloride

Particulars	Moisture	Total nitrogen	Total phosphate	Water-soluble phosphate	Citrate-insoluble phosphate	Total potash
	%	%	%	%	%	%
12 : 6 : 0 MIXTURE						
Initial analysis ...	3.49	13.47	6.19	5.73	0.15	...
Final analysis ...	8.38	12.41	6.19	0.66	0.43	...
12 : 6 : 6 MIXTURE						
Initial analysis ...	3.46	12.47	6.19	5.69	0.15	5.95
Final analysis ...	8.37	12.43	6.19	0.66	0.43	5.95

The results indicated that the urea-superphosphate mixture cannot be stored without reversion and such reversion is minimised if the mixture is used soon after it is made. Reversion may also be minimised by changing the fillers or by restricting the addition of urea to the optimum level.

Another study on the substitution of urea in fertiliser mixtures with special reference to the reversion of water-soluble phosphate was taken up in March, 1965 and completed in September, 1965.

In this study, NPK mixtures containing nutrients in the ratio of 4 : 8 : 12 were prepared with different proportions of urea and ammonium sulphate and with the different fillers, namely, sand and gypsum. Various proportions of urea and ammonium sulphate used under the main treatment for preparing these mixtures were : (1) 100 per cent urea, (2) 100 per cent ammonium sulphate, (3) 15 per cent urea + 85 per cent ammonium sulphate, (4) 25 per cent urea + 75 per cent ammonium sulphate and (5) 50 per cent urea + 50 per cent ammonium sulphate. Superphosphate and potassium chloride were used as phosphate and potash carriers. The sub-treatments included sand and gypsum.

The periodical analyses at monthly intervals were taken up for moisture, total nitrogen, total phosphate, water-soluble phosphate, citrate-soluble phosphate, citrate-insoluble phosphate and total potash. The results are furnished in Tables 3, 4 and 5.

TABLE 3

Storage Study on 4 : 8 : 12 NPK Mixture with Sand as Filler and Urea at Varying Levels

Particulars of analysis	Initial analysis (immediately on preparation)					Final analysis (after 180 days)				
	Proportion of urea					Proportion of urea				
	0	15	25	50	100	0	15	25	50	100
	%	%	%	%	%	%	%	%	%	%
Moisture	5.94	5.56	6.83	6.99	7.07	6.50	6.76	10.06	9.88	10.72
Total nitrogen	4.42	5.00	4.32	4.75	4.36	4.32	4.32	4.16	4.65	3.51
Total phosphate	7.91	8.77	8.19	7.99	8.25	7.91	8.80	8.19	8.00	8.25
Water-soluble phosphate ...	7.91	7.99	8.21	7.93	8.24	7.04	7.56	7.12	6.91	5.45
Citrate-soluble phosphate ...	...	...	...	0.06	...	0.75	0.15	9.00	0.80	1.81
Insoluble-phosphate	...	...	...	...	...	0.12	1.09	0.88	0.29	1.00
Total potash	12.12	12.21	12.21	12.25	12.08	12.70	12.32	12.20	12.64	12.32

TABLE 4

Storage Study on 4 : 8 : 12 NPK Mixture with Gypsum as Filler and Urea at Varying Levels

Particulars of analysis	Initial analysis (immediately on preparation)					Final analysis (after 180 days)				
	Proportion of urea					Proportion of urea				
	0	15	25	50	100	0	15	25	50	100
	%	%	%	%	%	%	%	%	%	%
Moisture ...	6.02	6.78	7.28	7.32	9.09	6.73	7.82	9.01	9.36	12.06
Total nitrogen ...	4.37	4.70	4.72	4.05	4.36	4.86	4.42	4.80	4.31	3.21
Total phosphate ...	8.10	8.11	8.70	8.20	8.86	8.13	8.04	8.68	8.05	8.63
Water-soluble phosphate	7.49	7.54	7.88	7.67	3.09	3.96	4.02	4.21	3.41	1.91
Citrate-soluble phosphate	0.01	0.14	0.11	0.09	0.02	3.17	2.52	2.95	2.93	3.00
Citrate-insoluble phosphate	0.60	0.47	0.71	0.44	0.55	1.08	1.50	1.52	1.72	3.72
Total potash ...	12.08	12.37	12·48	12.60	12.41	12.20	12.64	12.66	12.86	12.76

TABLE 5

Reversion of Phosphate in 4 : 8 : 12 NPK Mixture while on Storage for Six Months

Particulars	Proportion of urea				
	0	15	25	50	100
	%	%	%	%	%
Mixture with sand as filler	11.0	5.1	13.3	12.9	33.7
Mixture with gypsum as filler ...	47.1	47.7	46.6	55.5	76.4

The study has revealed that there is increase in moisture as the percentage of urea increases, and different fillers, namely, sand and gypsum have no influence on moisture content. Loss of nitrogen is more with urea than with ammonium sulphate. The reversion of water-soluble phosphate is more in the urea mixture and it increases with increased proportion of urea used. The water-soluble phosphate decreases with the storage time. The magnitude of reversion is more with gypsum as filler. The insoluble phosphate is found to increase on storage and it is highest in the mixture made with 100 per cent urea and gypsum as filler. There is no significant difference in total phosphate and potash content due to storage. The 25 per cent level of urea in manure mixtures may be taken as a safe limit.

To assess the deficiency of nutrients due to storage in a manure mixture with different nitrogenous fertilisers as nitrogen carrier, another study was carried out with three mixtures, as indicated in Table 6, containing calcium ammonium nitrate, urea, and ammonium sulphate. Chemical analyses for a period of six months were carried out at one month interval. The study revealed that the contents total nitrogen, total phosphate and total potash were stable in all the three mixtures. The water-soluble phosphate decreased considerably in calcium ammonium nitrate mixture and urea mixture whereas in the ammonium sulphate mixture there was only a slight loss of water-soluble phosphate after six months. The details of the study are furnished in Tables 6 and 7.

The higher rate of reversion in calcium ammonium nitrate mixture may be due to the highly hygroscopic nature of calcium ammonium nitrate and its chemical reaction with ammonium phosphate. In the case of urea mixture, the moisture absorbed by the fertiliser might have brought about interaction of ammonium phosphate with superphosphate resulting in the reversion of phosphate.

TABLE 6

Composition of Mixtures Prepared with Calcium Ammonium Nitrate, Ammonium Sulphate and Urea as sources of Nitrogen

Mixture I		Mixture II		Mixture III	
Calcium ammonium nitrate ...	40%	Ammonium sulphate ..	40%	Urea ...	50%
Ammonium phosphate ...	15%	Ammonium phosphate	15%	Ammonium phosphate	10%
Groundnut cake ...	20%	Groundnut cake ...	20%	Superphosphate ...	3%
Rock phosphate ...	11%	Rock phosphate ...	11%	Rock phosphate ...	10%
Filler : Gypsum ...	14%	Potassium chloride ...	10%	Groundnut cake ...	14%
		Filler : Gypsum ...	4%	Potassium chloride ...	5%
				Filler : Gypsum ...	8%
	100%		100%		100%

TABLE 7

Storage Study on Mixtures Prepared with Calcium Ammonium Nitrate, Ammonium Sulphate and Urea as sources of Nitrogen

Particulars	Moisture	Total nitrogen	Total phosphate	Water-soluble phosphate	Total potash	Free acid
	%	%	%	%	%	%
MIXTURE I						
Initial analysis	6.57	13.49	12.46	7.20	...	1.14
Final analysis	14.09	13.09	12.44	2.20	...	3.57
MIXTURE II						
Initial analysis	3.60	12.71	11.79	8.48	8.13	1.13
Final analysis	4.62	12.64	11.78	8.14	7.82	3.12
MIXTURE III						
Initial analysis	4.88	13.25	9.55	4.29	3.78	2.52
Final analysis	8.13	13.16	9.49	2.96	3.76	3.22

The straight fertilisers as well as the mixed fertilisers whose critical humidity is relatively low, need special care both for packing and storage. It is necessary that these fertilisers are packed in polythene-lined jute bags. It is aslo necessary, for fertilisers like superphosphate, to protect the jute bags from the action of free acid.

Proper storage of fertilisers

As the demand for fertilisers is seasonal and the production of fertilisers in factories is a continuous process, it is necessary that the fertilisers are stored in appropriate places.

The type of godowns for storage of fertilisers have an important bearing on the moisture percentage of the material. In *kutcha* godowns, the effects of variations in temperature and relative humidity of atmosphere are pronounced. Fertilisers stored in *kutcha* godowns show a high level of moisture in comparison to fertilisers stored in *pucca* godowns, during humid seasons of the year.

Warehouses for storage of fertilisers should be moisture proof, constructed with *pucca* flooring, plinth of two to three feet and walls plastered with cement or lime. The roof should be flat and about 16′ high. The doors and ventilators should be of shutter type that can be made airtight when required, especially during periods of high relative humidity. The capacity of each room in a warehouse may not exceed 200 tonnes. The warehouse should be away from places of fire hazards.

Proper dunnage is of primary importance to prevent the fertiliser bags from moisture damage. In the storage of fertilisers, damage occurs to the bottom layers of bags due to seepage of water from the floor and also because of the hygroscopic nature of the materials. By giving damp-proof treatment the seepage can be arrested. Wooden crate dunnage with a layer of matting over it is ideal since it gives a space of nearly 5″ above the floor level which enables free circulation of air under the stock and prevents droppings and spillings coming in direct contact with base floor. Normally, bags containing fertilisers should be stocked in piles of not more than 10 bags high and 6 bags width with about 3′ passage between each pile. This facilitates verification of stock. Under no circumstances, should any other commodity be stocked along with fertilisers in the same room or godown.

Role of mixed fertilisers in balanced nutrition

Mixed fertilisers consist of individual fertiliser materials blended together to permit distribution in the field in one operation. The use of mixed fertilisers has the following advantages:

(1) Fewer man-hours are required to apply a mixture than to apply its various materials separately, an important factor in areas where farm labour is scarce and expensive.

(2) Mixtures may have better physical condition and are more easily applied than many other fertilisers.

(3) The residual acidity of fertilisers can be conveniently and effectively controlled by the use of a proper quantity of neutralisers like dolomitic lime stone in the mixtures.

(4) Plant nutrients required in small amounts can be applied more evenly.

(5) If proper mixture is used for a particular type of soil and crop, less care on the part of the farmer is needed. Mixtures ensure right proportion of plant nutrients in the soil.

The fertiliser mixtures can be broadly classified into two types, namely, open formula and closed formula. Knowing the formula, one is able to judge the type and quality of the materials supplying the nutrients and their suitability for specific soils and crops. One can also determine roughly the quality of fillers used in the mixture. The ingredients of closed formula mixtures are not disclosed, so the farmer cannot be aware of the quality of the nutrients present in them

In Tamil Nadu, only closed formula system is in vogue. Neither the farmer nor the Fertiliser Chemist of the Agricultural College and Research Institute, Coimbatore, can know the ingredients in a particular fertiliser mixture. It is necessary to disclose the ingredients used. Citrate-soluble phosphatic materials can be used and accounted for water-soluble phosphate and, citrate-soluble phosphate is taken into account for purpose of guarantee. Likewise, certain nitrogenous materials like ammonium chloride are not suitable for potatoes. Similarly, potassium chloride is not useful for tobacco crop as the quality will suffer. Therefore, in the interest of the farmer and for genuine quality purpose, open formula must be insisted upon.

After the implementation of the Fertiliser (Control) Order, fertiliser workshop

seminars are being conducted from time to time to formulate fertiliser recommendations based on the experience gained at the agricultural research stations and on the results of fertiliser demonstrations in the cultivators' fields. In such seminars, all people such as manufacturers, sales organisations, cultivators, and all the departments of the government interested in the use of fertilisers, besides the specialists of the Agricultural Department, co-ordinate.

The first of its kind was held in 1959, the second in 1963 and the third in 1966. In the first seminar, 4 standard mixtures were formulated. In the second seminar, the standard mixtures were increased to 15 in number and in the third seminar they were suitably modified into 13 in number. At present there are 13 standard mixtures available in the fertiliser market.

Fertiliser studies

With the main objective to stream-line and strengthen the studies on soil science with particular emphasis on fertilisers and their reactions in the soil, a separate soil science unit was established in March, 1966 at the Agricultural College and Research Institute, Coimbatore. In this unit, special attention is being paid to the fundamental and applied aspects of soil and their reactions to the various types of fertilisers.

Initially two studies, namely, (1) comparative merits of straight and mixed fertilisers and (2) foliar spraying with urea and phosphatic materials were taken up. The details regarding the study on comparative merits of straight and mixed fertilisers are summarised below.

A pot culture experiment with ADT 27 as test crop was laid out in 1957–68. The NPK standard mixture 6 : 9 : 6 and two types of straight nitrogenous fertilisers, namely, ammonium sulphate and urea were used. The experiment was conducted in two types of soils, namely, black clayey soil and red loam. The dosage per acre was 28 kg. nitrogen, 21 kg. phosphate and 14 kg. potash. Phosphate was supplied through superphosphate and potash through potassium chloride. A basal dressing of green manure at 2,2 0 kg. per acre was given to the soils.

The treatment with the standard mixture as basal dressing and the straight nitrogenous fertilisers as top-dressing as per the departmental recommendations was found to be superior in increasing the grain yield of the crop. With respect to

straw yield, application of the straight fertilisers was found to be superior. Among the two soil types, black soil was found to respond better than red soil.

A field experiment was conducted in 1967–68 in ADT 27 paddy with the same treatments. In this experiment, the treatment receiving phosphate as basal dressing and nitrogen and potash as top-dressing recorded the maximum grain and straw yields of crop. Among the types of fertiliser mixtures, the fertiliser mixture with ammonium sulphate as nitrogen carrier was found to be superior to the fertiliser mixture with urea as nitrogen carrier.

In a pot culture experiment with CSH 1 cholam, in the year 1967–68, it was found that all the manurial treatments including farmyard manure significantly increased the grain and straw yields as compared with no manure.

In the year 1968–69, in the experiment with ADT 27 paddy crop in wet lands, the treatment with the standard mixture applied half as basal dressing and another half as top-dressing has given the maximum grain yield and the treatment that received the entire phosphate and half the dose of potash as basal dressing and the entire nitrogen and half the dose of potash as top-dressing has given the maximum straw yield. In this mixture ammonium sulphate was used as nitrogen carrier.

In the case of the other mixtures, having urea as nitrogen carrier, the treatment receiving half the dose of the standard mixture as basal and half the dose of standard mixture + half the dose of nitrogen as top-dressing has given the maximum grain yield and the treatment receiving no basal dressing and half the dose of nitrogen + the entire quantity of standard mixture as top-dressing has given the maximum straw yield.

Between the two types of fertiliser mixtures, the mixture containing ammonium sulphate was found to be superior to the mixture containing urea as nitrogen carrier.

Another pot culture experiment on IR 8 and ADT 27 varieties of paddy was carried with the NPK standard mixture 6 : 9 : 6 made out of straight fertilisers and complex fertilisers, namely, ammonium sulphate, ammonium sulphate nitrate, nitrophosphate, ammonium phosphate and 15 : 15 : 15 complex.

The recommended dosages, namely, 75 kg. of nitrogen, 35 kg. of phosphate and 35 kg. of potash per acre for IR 8 paddy and 28 kg. of nitrogen, 21 kg.

of phosphate and 14 kg. of potash per acre for ADT 27 paddy were applied with 2,250 kg. of green manure as basal dressing.

There was significant increase both in grain and straw yields in all the treatments over the control, both in IR 8 and ADT 27 varieties of paddy.

In the case of IR 8 paddy, the application of 6 : 9 : 6 mixture made of 15 : 15 : 15 complex had given the highest grain yield followed by the mixture made of ammonium phosphate. There was no significant difference in the other mixtures made out of the straight fertilisers, namely, ammonium sulphate nitrate, ammonium sulphate, and nitrophosphate. With regard to straw yield, ammonium phosphate had given the highest yield followed by nitrophosphate. There was no significant difference in the case of other three mixtures.

In the case of ADT 27 paddy, there was no significant difference in the grain yield between the treatments. With regard to straw yield also, there was no significant difference between the mixtures. But there was a slight increase in the case of the 6 : 9 : 6 mixture, made out of ammonium sulphate. However, based on this, it would be too early to offer any remarks on the superiority of complex fertilisers or otherwise and further field studies are required. Such studies have been recently formulated.

Micronutrient in mixed fertiliser

Deficiencies of one or more of the micronutrients may arise from their loss through weathering and leaching of the soil or through exhaustion by the use of heavy dressings of fertilisers containing only the major nutrients which may greatly stimulate crop growth. Generally micronutrient deficiencies are most likely to occur in highly weathered, course-textured soils, organic soils or calcareous soils.

Micronutrient elements are needed in minute quantities for crop growth and caution should be exercised when applying to prevent overdosage and consequent damage. These can be applied to crops by foliar spray. Spray effects are often temporary and frequent applications may be needed.

Micronutrients may best be mixed with the ordinary commercial fertilisers before application. It is important that the materials are uniformly mixed, so that there is no possibility of localised overdosage of the micronutrient elements. Some soils have high fixing capacity for some micronutrients and the deficiency of such micronutrients in those soils cannot be corrected by addition of

the element to the soil as happens with iron and zinc on some calcareous and alkaline soils.

Certain crops like lucerne, vegetables, root crops and apples are sensitive to boron deficiency. The deficiency may be corrected by soil application of boron. Boron as a micronutrient for groundnut has received considerable attention in Tamil Nadu. In the year 1962, under the Groundnut Physiology Scheme, application of borax at 5 to 7 kg. per acre has increased the groundnut yield by 20 to 30 per cent. Application of boron along with the mixed fertiliser is more economical instead of separate application. In order to find out the feasibility of mixing boron compounds with the standard fertiliser mixture prescribed for groundnut crop, a study was undertaken with the following treatments and the loss of nitrogen was studied for six months, along with the variation in mixture :

(1) NPK mixture alone

(2) NPK mixture + borax

(3) NPK mixture + boric acid

(4) NPK mixture + calcium tetra borate

(5) Superphosphate with borax + nitrogen + potash

(6) Superphosphate with boric acid + nitrogen + potash

(7) Superphosphate with calcium tetra borate + nitrogen + potash

There has been no change in the physical condition of the fertiliser mixture. Reduction in nitrogen content has been negligible and within the limits of analytical error. The variation in mixture also has not been significant; and it is concluded that whenever boron has to be applied to groundnut crop the boron compounds like borax, boric acid and calcium tetra borate can be mixed with the groundnut standard mixture and applied.

It is stated that deficiencies of iron may be corrected by direct application of the micronutrient on the foliage of plants. Under suitable conditions, soil application of zinc sulphate at 4 to 12 kg. per acre may be resorted to for zinc deficiency. For manganese deficiency, soil application of 10 to 40 kg. per acre of manganese sulphate may be resorted to. Molybdenum deficiency may be corrected by applying ammonium molybdate or molybdenum trioxide at the rate of 20 kg. per acre. Copper and boron deficiencies are common in organic soils. Copper deficiency can

be corrected by application of copper sulphate to soil at the rate of 2 to 15 gm. per acre. Copper is held in the exchange complex in soils and is not likely to be toxic to plants.

In Tamil Nadu, the Agricultural Department has implemented a scheme to study the micronutrient status of the soils of the State with the help of the Indian Council of Agricultural Research, New Delhi, and the work is in progress.

Pesticides in mixtures

Considerable quantities of fertiliser-pesticide mixtures are being used in several countries, including New Zealand, the United Kingdom and the United States of America. Such mixtures have the advantage of convenience in application to crops and often result in economy as compared with separate individual applications of the fertiliser and pesticide. The demand for fertiliser-pesticide mixture is increasing in volume in other countries even though it involves certain problems.

Summary

With a view to prohibit the manufacture, sale and distribution of spurious and substandard fertilisers, the Fertiliser (Control) Order was introduced in Tamil Nadu in August, 1957. It also enables the Government to fix the maximum prices for fertilisers.

Fertiliser samples that are drawn from different mixing centres and dealer points are sent to the Agricultural College and Research Institute, Coimbatore, for quality check up. The collection of samples is restricted as the facilities for analysis are not adequate.

It is proposed to have another unit at the Madurai Agricultural College, for timely analysis of more number of samples received from the southern districts.

Out of 6,357 fertiliser samples so far received, 1,996 samples were found to be deficient, mostly in water-soluble phosphate only.

All the analytical and fertiliser chemists should meet once a year to focus on the standardisation of analytical methods so as to have a uniform procedure throughout the country.

Storage studies were conducted on mixed fertilisers to assess the degree of reversion of phosphates. The citrate-soluble phosphate is now accounted for

against water-soluble phosphate. Open formula must be insisted upon to have better quality control.

The advantages of mixed fertilisers over straight fertilisers, with experimental data for different crops were discussed in detail in this paper.

The use of micronutrients in mixed fertilisers, namely, boron in groundnut mixture is already in vogue in Tamil Nadu. A study of the micronutrient status of the soils of Tamil Nadu is now in progress in co-ordination with the Indian Council of Agricultural Research, New Delhi.

The fertiliser-pesticide mixture is another important line of work to be tackled by the fertiliser industry.

The quality control and storage studies on fertilisers and the crop responses for mixed fertilisers in Tamil Nadu have all indicated that the fertiliser manufacturers and the manure mixing firms are contributing their best towards the wealth and welfare of farmers and also towards the relief of food shortage in our country.

FERTILISER MIXTURES—PROBLEMS AND PROSPECTS

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" For several decades in the past fertiliser mixing firms devoted quite an amount of effort to prepare specified grades of mixtures, to develop large distribution networks and to promote sales of these mixtures extending credit where necessary, often suffering bad debts. However, for some time past the mixture trade has been facing certain vicissitudes and currently the trade is in doldrums." All of us share this view with Prof. Krishnamurthy, our dynamic Regional Executive of the Southern Regional Branch of the Fertiliser Association of India However, I am not very clear to fully agree with Prof. Krishnamurthy that the trade devoted a lot of effort to make the farmer conscious of balanced fertiliser. From the trend of the mixture trade and consumption of balanced fertiliser one cannot get full conviction that adequate effort has been there in favour of application of balanced fertiliser.

General pattern of fertiliser consumption in India

In Table 1 data on consumption/distribution of nitrogen, phosphate and potash for the period 1959–60 to 1968–69 are given along with the ratio of NPK consumption for the years covered. For nitrogen, the period has been one of continuous progress, every year the consumption gaining ground with no relapse. For phosphate, generally, the period has been one of progress barring for two years 1965–66 and 1968–69, when consumption of phosphate went below the immediately preceding years. For potash also, generally, the period has been one of growth but during 1961–62 and 1968–69 potash consumption was below that of the years immediately preceding. The progress of NPK consumption is very interesting. The period reviewed started with a ratio of 1 : 0.24 : 0.09 and steadily progressed until in 1967–68 the best ratio was achieved at 1: 0.39: 0.18. In 1965–66, although phosphate consumption fell slightly, potash consumption retained the growth rate. In 1968–69, however, while nitrogen consumption continued to progress, consumption of both phosphate and potash fell appreciably.

Consumption figures and ratio for 1969–70 are yet to be collected. However, from available indications, it appears that nitrogen consumption has appreciably progressed while consumption of phosphate and potash have further declined. This situation would indicate that consumption of potash and phosphate has suffered leading to a set-back for application of balanced fertilisers. This reading is substantiated by informal indications that mixture sale is on the decline in 1969-70 in all the southern States.

Fertiliser consumption pattern in the southern zone

The data in Table 1 reveal the all-India situation. Since mixture trade is not uniformly popular in all the States, one must undertake a closer scrutiny of the situation in States where mixtures enjoy a reasonable standing. Although Andhra Pradesh has been out of the active picture with regard to mixtures, it can be said that generally the four southern States and Pondicherry are the major mixture markets. Maharashtra and West Bengal are the other two States where mixtures gained appreciable consumer acceptance. Unfortunately, due to reasons not to the liking of all concerned, in West Bengal the mixture trade has gone out of business for the last one year. In Maharashtra mixture business continues to be active although not as popular as in Tamil Nadu or Kerala. Mixtures are known and accepted in limited proportions in such States as Uttar Pradesh, Gujarat, Bihar and Assam.

Since the Seminar is concerned more with the mixture scene in the southern States, only, data relating to these States are being considered. An attempt has been made to analyse the mixture situation in the southern States in Tables 2 to 7. It is admitted that the data have certain limitations. In published fertiliser statistics, generally, no distinction is made between quantities distributed and quantities actually consumed. For calculations, generally, distribution figures are taken as consumption figures. Another limitation relates to establishing the actual consumption of nitrogen, phosphate and potash in mixture form as against the consumption in straight form through single-nutrient or multinutrient fertilisers. Further, while information is available on the total quantities of mixtures made and sold, information on the grades of mixtures made and sold is not available. It has, therefore, been necessary to arrive at a formula for calculation of nitrogen, phosphate and potash content of mixtures taking into account the recommended grades and their respective popularity. Still another limitation is the doubt whether reported figures of distribution of straight fertilisers include fertilisers that might subsequently have been used for preparation of mixtures. To eliminate the

possibility of double accounting an effort was made to verify figures. It was concluded that fertilisers supplied for preparation of mixtures had not been included in the figures of straight fertilisers, reported as distributed for straight consumption. These assumptions necessarily limit the accuracy of the data. However, to indicate the trend, the data are sufficiently adequate and conclusions have been drawn on this basis.

While analysing the data, it has been kept in view that during 1967–68 and 1968–69, most areas in the southern zone suffered from drought, for two/three seasons.

The following are the significant features of the fertiliser consumption pattern in the southern zone :

(1) Consumption trend of nitrogen is in keeping with the national trend ; it has recorded consistent progress from 232 thousand tonnes in 1964–65 to 464 thousand tonnes in 1968–69 ; the consumption has almost doubled.

(2) While consumption of nitrogen through single-nutrient and multinutrient straight fertilisers recorded a substantial increase, consumption of nitrogen through mixtures rose from 46 thousand tonnes to only 52 thousand tonnes. While in 1964–65 approximately 20 per cent of nitrogen application was through mixtures and 80 per cent through straight fertilisers, in 1968–69, only 11 per cent of nitrogen application was through mixtures and the balance 89 per cent nitrogen application was through straight fertilisers. This clearly shows that the share of mixtures as carrier of nitrogen has declined substantially. The highest percentage obtained was apparently in 1964–65 when it was nearly 20 per cent. Since then it has been gradually declining.

(3) Regarding phosphate, the total consumption through all forms of carriers in 1964–65 was approximately 111 thousand tonnes. In 1968–69, the corresponding figure was 160 thousand tonnes. Phosphate applied through mixtures in 1964–65 was 53 thousand tonnes and in 1968–59, the corresponding figure was 60 thousand tonnes. In 1964–65, 47 per cent of phosphate application was through mixtures, whereas in 1968–69 the share of mixtures declined to 37 per cent approximately. Phosphate consumption has been showing a steady increase from 111 thousand tonnes in 1964–65 to 229 thousand tonnes in 1967–68. But it declined to 160 thousand tonnes in 1968–69. While there has been a marginal

increase in the quantity of phosphate applied through mixtures it is clear that the share of mixtures as carriers of phosphate has declined.

(4) In 1964–65, approximately 74 thousand tonnes of potash were used. As against this, in 1968–69, the application was 120 thousand tonnes. Application through mixtures in 1964–65 was approximately 37 thousand tonnes, whereas in 1968–69 application through mixtures was 43 thousand tonnes. It is seen that while there is a marginal increase in the total quantity of potash applied through mixtures, total share of mixtures as carriers of potash has declined substantially by about 14 per cent.

(5) Consumption of single superphosphate was mostly through mixtures and when mixture sales declined, superphosphate consumption declined as straight sales of superphosphate did not increase to compensate the loss.

(6) The relative loss of phosphate and potash consumption due to decline in the sale of mixtures was not compensated by increase of phosphate and potash sale through multinutrient NP and NPK fertilisers.

Briefly, the situation appears to be that while nitrogen has gained ground, potash and phosphate have lost ground relatively. This would indicate that the growth of consumption of phosphate and potash did not keep pace not only with the growth of consumption of nitrogen, but also with straight single-nutrient and multinutrient fertilisers available. The preference of the farmer is for straight fertilisers rather than for mixtures. Obvious conclusions are that the concept of balanced fertiliser application has yet to be consolidated and that the popularity of mixtures is yet to be stabilised.

The statewise situation is not uniform. In Andhra Pradesh, there is hardly any mixture trade worth mentioning these days. Even in 1964–65 the position was not particularly worth mentioning. In Kerala, the mixture trade has not suffered a serious set-back. As far as growth is concerned the share of mixture is not appreciable. Bulk of the growth has gone in favour of straight fertilisers. In Mysore State the mixture has not been as popular as in Tamil Nadu and Kerala. In this State also, while, mixtures have made some progress in real terms it is seen that a substantial share of the additional consumption of fertilisers has been through straight fertilisers. In a way it can be said that Tamil Nadu has been the fortress of the mixture trade. However, in this State also it is true that mixtures have lost appreciably and could not get much of a share of the additional consumption; not only that most of the additional consumption has been through straight fertilisers but also in real terms mixtures have lost much ground.

General Inferences

Generally, it can be said that mixtures have been the main carriers of phosphate and potash whereas straight fertilisers have been the main carriers of nitrogen. This is as it should be keeping in view the requirement of nitrogen for top-dressing. In most cases phosphate and potash are applied to crops at the base.

While consumption of all the three nutrients has shown increase, NPK consumption ratio has gone against phosphate and potash ; also the share of mixtures in the total business has gone down. Here again we come to the same conclusion that both balanced fertiliser application as well as mixture application are yet to be stabilised.

Earlier, I have indicated my inability to accept that adequate effort has gone in for popularisation of the application of balanced fertilisers. I wonder whether the mixture trade has been popularising mixtures or whether it has been popularising balanced fertilisers. If the trade has been popularising balanced fertilisers NPK consumption ratio would have shown an improvement in favour of phosphate and potash whereas the indication is that the ratio has gone in favour of nitrogen and against phosphate and potash. It could be suggested that phosphate and potash also showed some increase. However, when it is realised that complex NP and NPK fertilisers were introduced in the market in recent years thereby restricting the freedom of farmers to take nitrogen without phosphate and potash thereby bringing about a *de facto* tagged sales of phosphate and potash with nitrogen, one could conclude that the farmer while taking nitrogen was forced to take phosphate and potash. This conclusion gains further validity from personal observation that when supply of straight nitrogenous fertilisers were inadequate farmers freely took mixtures, whereas when straight nitrogenous fertilisers were freely available farmers preferred such fertilisers to mixtures. It might be recalled that from 1964-65 to 1967-68 we had some sort of shortage for straight fertilisers. In most cases straight fertilisers were available only through cooperatives and were more or less rationed and sold tagged with mixed fertilisers. From 1968 onwards straight fertilisers were available in adequate quantities and tagging of mixtures with straight fertilisers was not possible. Perhaps the decline

the share of mixtures could be due to mixtures being not able to travel on ight fertilisers. Perhaps one could come to a tentative conclusion that pre- ence for mixtures was in the absence of straight fertilisers and not because of acceptance of the concept of balanced fertilisers on the part of the farmer. e experience of NPK complex fertilisers also more or less proves this point.

What could be the possible reasons for this drag on mixture sales? Perhaps, e had all been misled to a conclusion that mixtures were gaining popularity hen mixture sales were improving due to the absence of straight fertilisers. erhaps, we concluded that mixture sale was an indication of the acceptance of he concept of balanced fertilisers by the farmers. Perhaps, we believed that by opularising branded mixed fertilisers we would be popularising the concept of alanced fertilisers. These are suggestions not conclusions.

NPK physical mixtures have inherent disadvantages on account of fficulty of application, cost, and at times, on account of indifferent quality.

Can we stabilise and improve the share of mixtures in fertiliser consumption? am reminded of a discussion that I had with a senior colleague at the Mysore Session of the Southern Regional Committee of the Fertiliser Association f India, sometime in 1967. My friend posed the question, "how long will we be ble to carry on with physical mixtures and what improvements or diversification easures could we consider to consolidate the business of firms in the mixing ade?" We felt that powder mixture business, as we currently understand it, ill have only a relatively short life, say about 6 or 7 years. Those firms, who ould like to stabilise their position in fertiliser business on a long term basis, should nsider handling NPK straight fertilisers supplementing mixtures and handling uch other agricultural inputs as seeds, pesticides and agricultural implements nd equipments. Also, we felt that firms with adequate resources should, as oon as possible, develop granulation facilities by establishing medium size ranulation plants in key consumption centres. It was felt that even when actory-made NPK fertilisers are made available medium size granulation plants supplying tailor-made grades will have a future. It will be possible o obtain supplies of imported fertilisers, may be at concessional uniform

destination-delivered prices. Also, it was realised that a large number of single-nutrient fertiliser producers will continue in business for a number of years and these producers might like to make available ingredients at relatively lower prices to face competition from factory-made NPK producers. It might appear that granulated fertiliser will have to bear additional cost on account of double handling and packing. This is true but it might be possible to bring about economies of bulk handling and decentralised operation. I am inclined to believe that decentralised granulation facilities offer at least for the next 10 years a stable business for the firms who are currently in the business of manufacturing and marketing powder NPK mixtures, particularly those producing single superphosphate. It is likely that manufacturers of superphosphate and physical mixtures might get concessional prices and terms from the Central Fertiliser Pool for supply of imported fertilisers. I understand that a suggestion to this effect is currently under the consideration of the Government of India. Perhaps, this will give the required relief to mixture and superphosphate industries.

As a long term problem I am rather inclined to take the position that physically made powder mixtures will not have a long future in this country. In the process of progress from application of single-nutrient to the application of balanced fertilisers, physical mixtures have a key role to play. This, the mixture industry in the country has played and continues to play. In popularising balanced fertilisers the mixture industry has a role. This role also has been duly played by the industry. Perhaps, the fear that popularisation of balanced fertilisers without proper emphasis on the role of mixtures might work in favour of straight fertilisers and against mixtures, might have in the past encouraged promotion of branded mixtures rather than balanced fertilisers. Perhaps, we could have a useful second look at this problem. Stated briefly the problem is: should we popularise mixtures through popularising NPK balanced fertiliser application or should we popularise NPK balanced fertilisers through mixtures.

Technology and cost, I am afraid, are against a long life for physically made

powder mixtures. Not only factory-made NPK fertilisers will offer competition to mixtures but also bulk blending might soon come actively in the competition with mixtures. Old technology has to give place to a new technology. Economy and farmer preference will be in favour of new technology.

Progress is inherent in civilization. Perhaps it is wise to change with change if it is not possible to change ahead of change. The process of change should be smooth and there should be no room for sorrow and grief. The less painful and the less costly the process of change, the better it is for all concerned.

TABLE 1

Fertiliser Consumption in India, 1959-60 to 1968-69

Year	Nitrogen in tonnes	Phosphate in tonnes	Potash in tonnes	Ratio of NPK consumption
1959-60	229,326	53,930	21,342	1 : 0.24 : 0.09
1960-61	211,685	53,134	29,052	1 : 0.25 : 0.14
1961-62	291,536	63,932	27,982	1 : 0.20 : 0.10
1962-63	360,033	81,385	36,503	1 : 0.28 : 0.12
1963-64	406,976	116,674	50,570	1 : 0.28 : 0.12
1964-65	434,473	147,652	70,440	1 : 0.30 : 0.15
1965-66	547,363	132,178	77,746	1 : 0.23 : 0.15
1966-67	838,736	248,602	115,710	1 : 0.33 : 0.16
1967-68	1,057,785	422,096	205,578	1 : 0.39 : 0.18
1968-69	1,253,953	318,351	177,567	1 : 0.24 : 0.13

TABLE 2

Consumption of Nitrogen, Phosphate and Potash in Different Forms in Southern Zone

(in '000 tonnes)

Year	Nitrogen						Phosphate						Potash				
	Straight form				Mixture form	Grand total	Straight form				Mixture form	Grand total	Straight form			Mixture form	Grand total
	Single-nutrient	NP complex	NPK complex	Total			Single-nutrient	NP complex	NPK complex	Total			Single-nutrient	NPK complex	Total		
1964-65	171.6	14.5	...	186.1	46.3	232.4	42.6	16.4	...	59.0	52.5	111.5	36.9	...	36.9	36.7	73.6
	(73.8)	(6.2)	...	(80.0)	(20.0)	(100.0)	(38.2)	(14.7)	...	(52.9)	(47.1)	(100.0)	(50.1)	...	(50.1)	(49.9)	(100.0)
1965-66	187.5	21.6	...	209.1	49.3	258.4	35.2	23.7	...	58.9	55.6	114.5	49.6	...	49.6	38.4	88.0
	(72.5)	(8.4)	...	(80.9)	(19.1)	(100.0)	(30.8)	(20.7)	...	(58.5)	(48.5)	(100.0)	(56.3)	...	(56.3)	(43.7)	(100.0)
1966-67	329.5	44.2	...	373.7	66.7	440.4	40.4	54.0	...	94.4	75.4	169.8	82.5	...	82.5	51.4	133.9
	(74.9)	(10.0)	...	(84.9)	(15.1)	(100.0)	(23.8)	(31.8)	...	(55.6)	(44.4)	(100.0)	(61.6)	...	(61.6)	(38.4)	(100.0)
1967-68	335.6	67.8	9.4	412.8	61.9	474.4	43.3	108.9	9.4	161.6	67.9	229.5	66.7	9.4	76.1	47.4	123.5
	(70.7)	(14.3)	(2.0)	(87.0)	(13.0)	(100.0)	(18.9)	(47.4)	(4.1)	(70.4)	(29.6)	(100.0)	(54.0)	(7.6)	(61.6)	(38.4)	(100.0)
1968-69	360.2	41.0	10.4	411.6	52.7	464.3	34.5	54.8	10.4	99.7	60.3	160.0	66.6	10.3	76.9	43.0	119.9
	(77.6)	(8.8)	(2.2)	(88.6)	(11.4)	(100.0)	(21.6)	(34.3)	(6.5)	(62.4)	(37.6)	(100.0)	(55.5)	(8.6)	(64.1)	(35.9)	(100.0)
1969-70	(78.0)	(9.0)	(3.0)	(90.0)	(10.0)	(100.0)	(22.0)	(36.0)	(9.0)	(67.0)	(33.0)	(100.0)	(60.0)	(10.0)	(70.0)	(30.0)	(100.0)

Figures in brackets indicate percentage consumption. Figures for 1969-70 are estimates.

TABLE 3

Forms in Which Nitrogen, Phosphate and Potash Were Distributed in Kerala

(in '000 tonnes)

Year	Straight form												Mixture form			All forms		
	Single-nutrient			NP complex		NPK complex			Total				9.0	7.0	8.0@			
	N	P	K	N	P	N	P	K	N	P	K		N	P	K	N	P	K
1964-65	8.6	2.4	11.8	0.7	0.9	...	...	...	9.3	3.3	11.3		8.5	6.6	7.6	17.8	9.9	18.9
1965-66	6.3	3.3	20.5	0.9	1.1	...	...	...	7.2	4.4	20.5		9.4	7.3	8.4	16.6	11.7	28.9
1966-67	27.7	4.2	21.7	2.8	3.5	...	...	...	30.5	7.7	21.7		11.2	8.7	9.9	41.7	16.4	31.6
1967-68	22.1	3.3	21.5	3.6	6.5	...	...	...	25.7	9.8	21.5		12.8	10.0	11.4	38.5	19.8	32.9
1968-69	22.6	2.7	21.5	4.7	7.3	...	...	...	27.3	10.0	21.5		13.2	10.3	11.8	40.5	20.3	33.3

@ Weighted average.

TABLE 4

Forms in which Nitrogen, Phosphate and Potash were Distributed in Andhra Pradesh

(in '000 tonnes)

Year	Straight form												Mixture form			All forms		
	Single-nutrient			NP eomplex		NPK complex			Total				11.0	7.0	4.0@			
	N	P	K	N	P	N	P	K	N	P	K		N	P	K	N	P	K
1964-65	63.3	22.4	2.7	8.3	8.7	...	...	...	71.6	31.1	2.7		4.7	2.9	1.7	76.3	34.0	4.4
1965-66	65.1	15.0	5.6	13.7	13.8	...	...	...	78.8	28.8	5.6		4.7	3.0	1.7	83.5	31.8	7.3
1966-67	151.5	12.1	9.6	23.4	24.2	...	...	...	174.9	36.3	9.6		7.4	4.7	2.7	182.3	41.0	12.3
1967-68	121.2	16.2	4.0	26.1	32.2	1.1	1.1	1.1	148.4	49.5	5.1		8.3	5.3	3.1	156.7	54.8	8.2
1968-69	103.1	14.7	4.1	17.8	18.8	1.1	1.1	1.0	122.0	34.6	5.1		1.5	1.0	0.5	123.5	35.6	5.6

@ Weighted average

TABLE 5

Forms in which Nitrogen, Phosphate and Potash were Distributed in Mysore

(in '000 tonnes)

Year	Straight form											Mixture form			All forms		
	Single-nutrient			NP complex		NPK complex			Total			9.0	9.5	4.0@			
	N	P	K	N	P	N	P	K	N	P	K	N	P	K	N	P	K
1964-65	27.3	9.2	8.5	7.8	1.1	...	...	...	28.1	10.3	8.5	6.1	6.4	2.7	34.2	16.7	11.2
1965-66	30.1	8.0	7.1	1.4	1.7	...	...	...	31.5	9.7	7.1	8.4	8.8	3.7	39.9	18.5	10.8
1966-67	45.9	9.4	16.1	6.2	7.2	...	...	...	52.1	16.6	16.1	10.0	10.6	4.4	62.1	27.2	20.5
1967-68	50.1	12.3	15.9	15.8	28.1	0.9	0.9	0.9	76.8	41.3	16.8	8.2	8.7	3.7	85.0	50.0	20.5
1968-69	100.5	9.8	15.9	9.6	14.9	2.1	2.1	2.1	115.2	26.8	18.0	7.7	8.2	3.4	122.9	35.0	21.4

@ Weighted average.

TABLE 6

Forms in Which Nitrogen, Phosphate and Potash Were Distributed in Tamil Nadu

(in '000 tonnes)

Year	Straight form												Mixture form			All forms		
	Single-nutrient			NP complex		NPK complex			Total				10.0	13.5	9.0@			
	N	P	K	N	P	N	P	K	N	P	K		N	P	K	N	P	K
1964-65	59.5	8.6	14.4	4.6	5.7	...	...	...	64.1	14.3	14.4		25.5	25.5	23.0	89.6	48.8	37.4
1965-66	66.0	8.9	16.	5.6	7.0	...	...	...	71.7	15.9	16.4		25.7	34.6	23.1	97.3	50.5	39.5
1966-67	77.4	14.7	34.8	11.6	18.9	...	...	...	89.0	33.6	34.8		38.1	51.5	34.3	127.1	85.1	69.1
1967-68	114.9	11.4	25.1	21.9	41.2	7.3	7.3	7.	144.1	59.9	32.4		32.6	44.0	29.3	76.7	103.9	61.7
1968-69	112.1	7.2	25.1	8.9	13.8	8.6	6.6	6.6	127.6	27.6	31.7		30.1	40.6	27.1	157.7	68.2	58.8

@ Weighted average.

TABLE 7

Forms in Which Nitrogen, Phosphate and Potash Were Distributed in Pondicherry

(in '000 tonnes)

Year	Straight form											Mixture form			All forms		
	Single-nutrient			NP Complex		NPK Complex			Total			10.0	13.5	9.0@			
	N	P	K	N	P	N	P	K	N	P	K	N	P	K	N	P	K
1964-65	0.4	...	...	...	...	...	...	...	0.4	...	...	1.4	2.1	1.7	1.8	2.1	1.7
1965-66	0.6	...	...	...	...	...	...	...	0.6	...	...	...	...	...	0.6	...	...
1966-67	0.8	...	0.4	0.2	0.2	...	...	...	1.0	0.2	0.4	...	...	...	1.0	0.2	0.4
1967-68	1.6	...	...	0.4	0.9	...	...	...	2.0	0.9	...	...	...	...	2.0	0.9	...
1968-69	0.7	...	...	...	...	0.3	0.3	0.3	1.0	0.3	0.3	0.2	0.3	0.2	1.2	0.6	0.5

@ Weighted average of Tamil Nadu.

Resume, Recommendati
and Particip

RESUME OF THE SEMINAR

With the rapid technological progress in fertiliser manufacture, the trend throughout the world is towards manufacture of high analysis granulated NP or NPK compounds. India is no exception to this development. It is expected that high analysis granular complex fertilisers will have major contribution in our future fertiliser production and consumption programmes. This technological development had, however, an inadvertent effect on the mixed fertiliser industry in the country, as elsewhere abroad. There are more than 750 mixed fertiliser units in the country which have invested considerably and established a widespread distribution network. In spite of the tremendous progress made in the production and consumption of fertilisers in India, the mixture industry which is more than 55 years old, has remained at a comparatively lower level of development. The reasons are many in number and diverse in nature.

The Southern Regional Committee of the Fertiliser Association of India organised a one-day seminar on "Fertiliser Mixtures—Their Role, Current Trends and Future Prospects" on March 15, 1970 at Madras to review the situation of this industry, to analyse the reasons for its present position and to suggest measures to rehabilitate this industry so that it can continue to serve the cause of agricultural development. The Seminar was inaugurated by Dr. (Mrs.) Satyavanimuthu, Minister for Agriculture and Harijan Welfare, Government of Tamil Nadu. The inaugural session was presided over by Mr. T. A. S. Balakrishnan, Member, Board of Revenue, Government of Tamil Nadu. A large number of delegates from fertiliser industry and the departments of agriculture of Kerala, Tamil Nadu, Andhra Pradesh and Mysore State participated in the Seminar.

Inaugural session

In his welcome address, Mr. S. Prabhakaran Nair, Chairman of the Southern Regional Committee of the Fertiliser Association of India, reviewed the fertiliser consumption in the country in general and in the southern region in particular and pointed out that this region alone accounted for 45 per cent of nitrogen, 35 per cent of phosphate and 50 per cent of potash consumption in the country. In fertiliser mixture consumption also this region ranked first in the country.

However, there had been significant drop in the consumption of fertiliser mixtures in the last three years. He said that the Seminar would analyse the reasons for this decline and suggest suitable measures to boost the consumption of fertiliser mixtures so that this industry could be put again on a sound footing and made capable of facing the competition arising from technological developments. He urged the Government of Tamil Nadu to consider abolition of sales tax on fertilisers and the proposed levy of surcharge on sales tax. Such levies increased the cost of fertilisers to farmers in general and hampered the growth of mixed fertiliser industry in particular.

Dr. (Mrs.) Satyavanimuthu, Minister for Agriculture, Government of Tamil Nadu, in her inaugural address commended the work of the fertiliser firms in supplementing the Government's efforts in increasing fertiliser consumption in Tamil Nadu. She referred to the steps taken by the State Government in boosting fertiliser consumption and said that the Government had established seven soil testing laboratories and had been carrying out a large number of demonstrations to popularise efficient fertiliser use. Referring to the difficulties of the fertiliser mixture industry, the Minister said that the mixture industry should keep pace with the technological progress in fertiliser manufacture and try to reduce the cost of mixed fertilisers through improvements in products, services and promotional activities. She said that the Government would consider the recommendations of the Seminar to rehabilitate the mixture industry.

In his presidential address, Mr. Balakrishnan reviewed the papers presented at the Seminar in a nutshell and said that the promotional activities and the programmes of farmer-education of the mixed fertiliser industry must be modernised and intensified, particularly, in view of the stiff competition from high analysis complex fertilisers. He referred to the intensive agricultural development and fertiliser programmes that were being undertaken by the Department of Agriculture of the Tamil Nadu Government in different districts of the State and asked the mixture industry to cooperate and actively participate in such programmes to achieve the fertiliser consumption and food production targets. Credit availability was one of the major factors in increasing fertiliser consumption. He suggested that fertiliser industry, banks, cooperative societies, etc., should discuss this problem and make joint efforts in offering liberal credits to farmers. Mr. Balakrishnan said that the Food Corporation of India could help in recovering loans by purchasing foodgrains from ryots and repaying the loans to credit institutions. He mentioned that the Tamil Nadu Government would welcome discussions on

Mr. S. Prabhakaran Nair, Chairman of the Southern Regional Committee of the Fertiliser Association of India, delivering the welcome address.

Dr. (Mrs.) Satyavanimuthu, Minister for Agriculture, Government of Tamil Nadu inaugurating the Seminar. Presiding over the inaugural session is Mr. T. A. S. Balakrishnan, Commissioner, Food Production, Government of Tamil Nadu.

Mr. B. A. Revappa, Fertiliser Officer, Government of Mysore, addressing the delegates at the technical session. Presiding over is Mr. A. Radhakrishnan, Joint Director of Agriculture, Government of Tamil Nadu.

easures to rehabilitate the mixture business with the fertiliser industry in the ght of the recommendations of the Seminar.

Mr. V. Venugopal, Director of the Fertiliser Association of India and former Chairman of the Southern Regional Committee of the Fertiliser Association of India, proposed a hearty vote of thanks at the conclusion of the inaugural session.

Technical session

Eight papers were presented in the technical session, which was presided over by Mr. A. Radhakrishnan, Joint Director of Agriculture, Government of Tamil Nadu. The papers reviewed the developments in the fertiliser mixture industry since its inception and the trends in consumption of fertiliser mixtures. It was observed that consumption was decreasing rapidly since 1966–67. The papers analysed the reasons for this decline and attributed the fall in consumption of fertiliser mixtures to (1) high cost of physical mixtures which in turn was due to (a) higher cost of nitrogen supplied to mixture industry, (b) costs involved due to double haulage, mixing, bagging, etc., and (c) double incidence of sales tax levied by some State Governments—once on straight fertilisers and secondly on the mixtures prepared from already taxed straight fertilisers, (2) low analysis of most of the mixture grades prevalent in the country resulting in higher transport, bagging and application costs, (3) pulverised or powder form in which most of the mixtures were sold which resulted in fear of adulteration, (4) stiff competition from high analysis granular complex fertilisers which were becoming increasingly available from imports as well as indigenous production and in which the per unit nutrient costs were lower and the fear of adulteration was much less, (5) inadequate credit facilities, and (6) lack of intensive promotional activities for increased use of fertiliser mixtures in the interest of balanced fertilisation.

Several suggestions were made in the papers presented at the Seminar to rehabilitate the mixture industry. Keeping in view the technological progress in fertiliser manufacture, it was suggested that physical mixtures should be granulated to avoid fear of adulteration. Granulation would enable production of high analysis products and bulk blending of such granular products, which in turn would provide analysis flexibility in grade formulations. It was suggested that nitrogen should be supplied at the Central Fertiliser Pool price to mixture manufacturers and not at the consumer price which was hitherto practised. It was also suggested that a few special mixtures should have organic nitrogen in

them. This would facilitate certain special crops like potato and sugarcane getting the benefit of the sustained action of organic nitrogen over a prolonged period. It was suggested that the mixture manufacturers should take up distribution of high analysis complex fertilisers through their distribution system.

Plenary session

Based on the various suggestions made and the discussion thereon, the Seminar finalised the recommendations in the plenary session, presided over by Mr. S. Prabhakaran Nair, Chairman of the Southern Regional Committee of the Fertiliser Association of India.

Prof. D. V. G. Krishnamurthy, Regional Executive of the Southern Regional Branch of the Fertiliser Association of India, proposed a vote of thanks at the conclusion of the Seminar.

RECOMMENDATIONS OF THE SEMINAR

In order to reduce the cost of mixed fertilisers and make them available at competitive and cheaper prices to farmers, it is absolutely necessary that nitrogenous fertilisers are made available to mixture manufactures at the Central Fertiliser Pool price and not at the consumer price. This Seminar reiterates strongly this recommendation made earlier by the Fertiliser Distribution Enquiry Committee in 1960 and the Sivaraman Committee in 1965.

Sales tax on fertilisers should be at single point only and sales tax on mixtures should be abolished in as much as the ingredients used for making mixtures already suffer sales tax.

Fertilisers should be exempted from the proposed levy of surcharge on sales tax in Tamil Nadu.

Keeping in view the compulsion of the technological developments, the mixing firms, may take measures to adopt bulk blending and granulation.

The new fertiliser factories should utilise the distribution channels established by the mixed fertiliser industry for distribution of their products so that the mixing firms will not be displaced but will be rehabilitated.

The proposed Fertiliser Promotion Council should intensify and co-ordinate the promotional activities of the Central and State Governments and the fertiliser manufacturers, so as to achieve the targeted fertiliser consumption.

All the mixing firms should actively associate themselves with the promotional activities like farmers' training, national demonstrations, etc., so as to create a better demand for fertilisers and promote efficient utilisation of plant nutrients.

Considering the need for providing adequate credit which is the key factor for increasing the consumption of fertiliser, the Government of India may be requested to assign priority for fertiliser credit. The commercial banks, particularly the nationalised banks should be persuaded to liberalise their credit policy and provide adequate credit to the manufacturers, distributors as well as farmers. Central and State Governments should also expand their credit facilities through cooperatives and block agencies.

State Governments should prescribe mixtures with micronutrients for crops and soils where they are needed to maintain the fertility status and get profitable returns from crops.

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